CHALLENGE 3

Be a Renewable Star!

GREEN HOMES CHALLENGE

FREDERICK COUNTY, MARYLAND

RENEWABLE STAR

HANDBOOK

Frederick County Office of Sustainability and Environmental Resources

Ensuring Our County's Future

A sustainable community starts at home . . .

FREDERICK COUNTY MARYLAND 1748

Frederick County Green Homes Challenge
Renewable Star Handbook

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GREEN HOMES CHALLENGE
FREDERICK COUNTY, MD

Renewable Star Handbook Guide

What is the Green Homes Challenge?

The Green Homes Challenge guides, rewards, and recognizes households for saving energy, adopting green lifestyle practices, and using renewable energy. Three corresponding Challenges make up the overall Green Homes Challenge:

Challenge 1: Be a Power Saver!
Challenge 2: Be a Green Leader!
Challenge 3: Be a Renewable Star!

The Renewable Star Challenge

This Challenge is all about clean energy – that is, electricity or heat generated from a renewable resource that emits little or no pollution in the generation process. Clean renewable energy can be generated from wind, sunlight, thermal energy stored in the ground, methane from landfills, or sustainable biomass, like crop waste.

Maybe the last time you dreamed of solar panels or other clean technologies for your home, you passed it off thinking "I just don't know enough about it" or "I could never afford something like that." Well, this handbook is geared for homeowners and renters just like you. In addition to our Renewable Energy Action Catalog, this handbook includes in-depth chapters about renewable energy options and technologies. By putting all the information you need in one place, this handbook can help any household use renewable energy for power, heating, cooling, or generating hot water. It also shares how individuals can support the development and expansion of renewable energy industries in the good old U.S.A.

- To become a Certified Renewable Star, complete the 3 Required Renewable Star Steps on the next page. While some of the actions in this Challenge are substantial, there are some easy ones too and you only need 10 Green Points to certify!
- Certified Renewable Stars may receive recognition and rewards for their efforts, including certified household signage, prize drawings, recognition by public officials, and opportunities for interviews and profiles.

★ **EXTRA!** The Renewable Star Challenge includes some time limited special initiatives, such as the **Solarize Frederick County** grants and volume purchasing program. Visit *www.FrederickCountyMD.gov/GreenHomes* for information on these initiatives.

We're Here to Help

- Our goal is to provide enough structure, support, and follow-up to help you stay motivated and on track – we understand that all of your household members are engaged in lots of other pressing matters and activities.
- **Request a Navigator,** a personal coach who can help you take action, stay motivated, and complete certification.
- Have questions or need help? Contact the Green Homes Challenge staff at 301.600.7414 or *GreenHomes@FrederickCountyMD.gov*.

Get started today.
Make a difference and Be a Renewable Star!

Already a Renewable Star?

If your household is already using renewable energy, you can use the Renewable Star Challenge to certify your home, be recognized, and earn rewards. Register with the Green Homes Challenge, check off actions already taken that total 10 Green Points, and submit your certification form.

Renewable Star Steps

Step 1: Register with the Green Homes Challenge

Complete and submit the Green Homes Challenge Registration Form on page 59 or online at *www.FrederickCountyMD.gov/GreenHomes* or *www.FrederickGreenChallenge.org*

Take the Green Homes Challenge Pre-Survey (optional)

Find out how green your household already is! If you have not already taken the Pre-Survey as part of the Power Saver or Green Leader Challenges, this online survey will help gauge your level of awareness and action in the areas of energy efficiency, green living practices, and renewable energy. By taking the survey, you'll be part of a select group that helps to evaluate the effectiveness of the Green Homes Challenge! Take the survey at *http://tinyurl.com/3c86c2v*

Step 2: Implement Renewable Energy Actions

Turn to page 6 and start selecting actions from the Renewable Energy Actions Catalog. Earn 10 points by implementing any combination of actions.

Use the Renewable Star Certification Form on page 43 to track your actions as you go, or track your actions online at *www.FrederickGreenChallenge.org*.

Total Points Available: 100
(Total of 100 assumes that the maximum points likely earned from Actions 1 and 2 is 20.)

Step 3: Submit your Renewable Star Certification Form

Turn to page 43 to complete your Renewable Star Certification Form. Alternatively you can certify online at *www.FrederickGreenChallenge.org*.

Submit the form by email, mail, or fax to:

Green Homes Challenge Coordinator
Frederick County Office of Sustainability
and Environmental Resources
30 North Market Street
Frederick, MD 21701
GreenHomes@FrederickCountyMD.gov
Fax: 301.600.2054

Renewable Energy Actions

How to use your Renewable Energy Actions Catalog

The Renewable Energy Actions Catalog lists actions that your household can take to use and support renewable energy. Each action has a "Green Point" value based on its relative environmental benefits. You may be curious about why certain actions have a higher or lower point value assigned. Point values were based on the priority environmental benefits identified by our partners and office including emissions reductions and energy savings. In order to achieve Renewable Star Certification, your household must complete the steps listed on page 5 and earn 10 points by completing any combination of actions from the Renewable Energy Catalog. You can also earn points for actions that you have already completed.

The Renewable Energy Actions Catalog Online

You can use this hard copy handbook in conjunction with our interactive **Online Green Homes Challenge** in order to access links to additional online resources: *www.FrederickGreenChallenge.org*

Symbols used in the Renewable Star Handbook

Hammers denote the relative amount of effort needed to implement a Green Action.

Dollar signs denote the relative cost of implementing a Green Action.

FREE No cost $ <$100 $ $ $100 - $500 $ $ $ $501 - $2,000 $ $ $ $ >$2,000

A key denotes a Renter-Friendly Green Action.

Photo Credit: Miss.hyper at the English language Wikipedia [GFDL (www.gnu.org/copyleft/fdl.html) or CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0/)], from Wikimedia Commons.

For an interactive experience with the **Renewable Star Challenge**, visit *www.FrederickGreenChallenge.org*.

1. Purchase clean renewable energy through your utility.

GREEN POINTS 20

GREEN POINTS 10

a. Purchase 100% of your home's electricity from renewable energy sources. (20 pts)

b. Purchase 50% of your home's electricity from renewable energy sources. (10 pts)

Potomac Edison is the utility that provides electric service and billing to most Frederick County homes*; however, customers can choose to receive their actual electricity from either Potomac Edison or a different energy supplier. In 2011, 3.44% of Potomac Edison's electricity came from clean renewable sources, such as hydroelectric plants and wind farms[1]. You can choose an alternate supplier; some offer plans with 50% or 100% of electricity generated from wind farms. Maryland's utility consumer advocacy office, The Office of the People's Counsel, posts current retail electricity suppliers and rates[2]. Suppliers may allow you to lock in your electricity rate for one or two years. Rates vary slightly depending on your preferences and may be very similar to what you are currently paying for electricity.

No matter which company you choose for your electricity supplier, Potomac Edison will still provide your bill, which will include the normal charges for electric service/delivery provided by Potomac Edison. It will also include the charges for electricity usage provided by your alternate supplier. The same electric wires will bring power to your home and you will still contact Potomac Edison if the power goes out or have other service problems.

Depending on the provider, as of the time of this publication, powering your home with wind-generated electricity may add as little as $0.006 per kilowatt hour (kWh) if you opt for 50% wind power; 100% wind-generated power may add approximately $0.01 per kWh. That's only between $3 and $12 per month for an average home to help clear our air and reduce our dependence on fossil fuels.

Electricity is electricity regardless of its source. For example, once electricity generated from a wind farm enters the grid, it is indistinguishable from electricity generated from a coal plant. So how can an electricity supplier claim to be selling wind-generated power? For an explanation, turn to Action 2 or Chapter 2 and learn about Renewable Energy Certificates.

Take Action:

1. View current electricity suppliers and rates from the Office of the People's Counsel website[2]. (Scroll down for the Potomac Edison Service Area.)
2. Investigate options with current clean energy suppliers. (If you want to sign up online, you will need your Potomac Edison account number.)
3. Sign up with a provider for either 100% or 50% wind-generated electricity.

To learn more about this topic, read

a. ***Chapter 1: Clean Renewable Energy – The Basics*** on page 18

b. ***Chapter 2: Renewable Energy Certificates*** on page 21

* The Town of Thurmont has its own electric utility.

2. Purchase Renewable Energy Certificates (RECs) to offset your household's greenhouse gas emissions.

GREEN POINTS 20

GREEN POINTS 10

a. Purchase RECs to offset 100% of your home's electricity use. (20 pts)

b. Purchase RECs to offset 50% of your home's electricity use. (10 pts)

If you live in Thurmont and cannot purchase electricity from renewable sources through your utility, or if you are interested in offsetting your household's greenhouse gas emissions, purchasing Renewable Energy Certificates (RECs) is a flexible option that supports the growth of the renewable energy sector.

RECs quantify the amount of clean energy a power generator has produced from a clean, renewable source, such as wind or solar. Every megawatt-hour (1,000 kilowatt-hours) of electricity generated from a renewable source is assigned a unique Renewable Energy Certificate, also known as a "green tag". Most RECs are certified by a third-party entity, such as Green-e, and sold as a commodity to offset the pollution from electricity generated by burning fossil fuels. Whoever owns or purchases a REC can claim ownership of the environmental benefits attributable to clean renewable energy projects. For an in-depth explanation of how RECs work, turn to *Chapter 2: Renewable Energy Certificates* on page 21.

You can purchase RECs from a REC marketer; some of these marketers make it easy for individuals and families to purchase RECs online. Some marketers are geared for commercial operations.

Purchasing RECs will not affect your utility bill; you will be billed separately by your utility and REC Marketer.

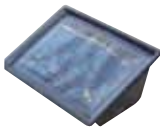
Take Action:

1. Shop for a REC marketer that sells RECs to individuals or families at the U.S. Department of Energy's Green Power Markets[3]. Some marketers make online purchasing easy for households.

2. Determine how many RECs you need per year to offset 100% or 50% of your electricity use. Use your electric bill and find the "Usage History" on the bill. Use the "Last 12 Months Use" or take the "Average Monthly Use" and multiply it by 12 to get an estimate of your annual energy use.

3. Purchase Renewable Energy Certificates from a REC marketer.

To learn more, read ***Chapter 2: Renewable Energy Certificates*** on page 21.



GREEN POINTS 1

3. Use a solar oven or cooker.

If you have access to a sunny yard, patio, or deck, solar ovens (also known as solar cookers) provide a simple and safe way to cook without consuming fuel or electricity. You can choose from several design options including a box oven, parabolic cooker, and a panel cooker. Temperatures can reach 200 – 400°F making the cookers suitable for everything from cooking rice and stews, to baking apples and biscuits. It does take longer to cook with a solar cooker, however, so you will need to plan ahead, much the same way you would if using a crock pot.

Take Action:

1. Enter "solar ovens" in your internet browser to learn more about options and products available online.
2. Learn how solar cooking is improving social, economic, and environmental conditions around the world through these organizations:
   - The Solar Oven Society[4]
   - Solar Household Energy, Inc.[5]
   - Solar Cookers International[6]
3. Purchase or make a solar oven and commit to using it.

To learn more about this topic, read the Solar Cookers International[6] Solar Cooking Basics web pages on *How Solar Cookers Work*, *Why Solar Cook?*, and *Health and Safety*.

GREEN POINTS 2

4. Use bio-heating oil in your furnace.

Even if you heat your home with an oil burning furnace, you can burn a more renewable fuel by using bio-heating oil, which is traditional home heating oil blended with 5% Biodiesel (known as B5). Biodiesel is made in the U.S.A. from soy, corn, and other vegetable oils, animal fats, recycled restaurant oils, and other natural sources. New sources, such as algae and cellulose from switch grass, cornstalks, and other plants, are under investigation. As an incentive, the State of Maryland offers a Bio-Heating Oil Tax-Credit[7] of up to $500 for using bio-heating oil through 2017. Bio-heating oil costs are similar to traditional heating oil costs.

Take Action:

1. Locate a bioheat distributor serving Frederick County through the National Biodiesel Board's online Bioheat Dealer Locator[8] at *Bioheatonline.com*.
2. Purchase bio-heating oil from a distributor serving Frederick County.
3. Claim your Maryland Bioheat Tax Credit[7].

Learn more about bioheat production, advantages, and more on the Bioheat website[9].

5. Use efficient furnaces and stoves designed for biomass fuels.

GREEN POINTS 3

GREEN POINTS 2

a. Replace an older inefficient wood burning stove with a new efficient wood or pellet stove. (3 pts)

b. Purchase a new efficient biomass stove or furnace. (2 pts)

Residential biomass furnaces and stoves are an alternative to heating oil furnaces or electric systems; they burn renewable materials like wood, wood pellets, corn, or nutshells. Biomass is a renewable energy source because the carbon dioxide emitted when it is burned can be recaptured if the biological source used is replanted. Depending on home size and layout, free-standing biomass stoves can provide all of a home's heating needs or supplement traditional heating systems. Biomass furnaces and boilers are designed to replace traditional furnaces.

The Maryland Energy Administration's (MEA) Clean Burning Wood Stove Grant Program[10] offers $400 grants for approved wood-burning stoves and $600 for approved pellet-burning stoves. A wide variety of stove and furnace options are available; enter "biomass stove" or "biomass furnace" into your internet browser to review products on the market, or review the lists of stoves eligible for the grant program.

Take Action:

1. Review the List of Wood Burning Stoves Eligible for the Maryland Grant[11].
2. Review the List of Pellet Stoves Eligible for the Maryland Grant[12]. (Note, this Washington State list is used by the Maryland Energy Administration.)
3. Purchase a clean-burning biomass stove or furnace and apply for the Maryland Clean Wood Stove Grant Program.

Learn more about biomass through the Union of Concerned Scientists' web page on How Biomass Energy Works[13]. There are differing opinions about the environmental impacts of biomass stoves and furnaces. Enter "biomass stoves pros and cons" in your internet browser to learn more.

6. Use biofuel in your flexible fuel or diesel vehicle.

GREEN POINTS 2

If you drive a flexible fuel vehicle (FFV), you can use a more renewably generated fuel by purchasing ethanol instead of gasoline. E85 is an abbreviation for a fuel blend of up to 85% ethanol fuel and gasoline. Ethanol is produced by fermenting and distilling starch crops (primarily corn) and about one-third of all gasoline sold in the U.S. contains 10% ethanol. Controversy remains about the efficiency of ethanol production and its impact on energy use, agriculture, and vehicle fuel efficiency, so you may want to learn more before making a decision that is right for you. The price per gallon is comparable to gasoline but varies by region; however, according to the Department of Energy's *fueleconomy.gov* web site, which is the official U.S. Government source for fuel economy information, FFVs operating on E85 usually experience a 25–30% drop in miles per gallon due to ethanol's lower energy content.

If you drive a diesel vehicle, you can use fuel-grade biodiesel. Biodiesel is an alternative to standard diesel fuel that is made from biological, non-toxic, and renewable ingredients, such as plant oils or animal fat. Biodiesel, which can be used in diesel engines with little or no modification, is usually blended with standard diesel fuel**.** The most common blend is B20, or 20 percent biodiesel to 80 percent standard; however, as of 2012, only B5 is offered at stations around Frederick County.

Ethanol and Biodiesel are relatively new to the consumer market so availability is currently limited to a handful of gas stations.

Take Action:

1. Use *E85Locator.net*[14] to find nearby E85 gas stations and purchase E85 for your flex fuel vehicle.

2. Use the Sustainable Biodiesel Alliance's NearBio[15] website to find nearby biodiesel stations and purchase biodiesel for your diesel vehicle.

Learn more about biodiesel, ethanol, and the benefits of biofuels from the Energy Future Coalition[16]. For information about the ethanol controversy or environmental and social issues related to ethanol, search for "corn ethanol" in Wikipedia, or enter "ethanol controversy" in your web browser.

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GREEN POINTS 10

7. Install a solar water heating system.

Solar water heating systems, also known as solar thermal systems, are a simple, reliable, and cost-effective method of harnessing the sun's energy to heat water for your home. Solar thermal systems collect energy from the sun to heat a fluid which then transfers its heat directly or indirectly to your water supply. A solar thermal system can supply 50 – 80% of a typical household's hot water needs[17].

According to the U.S. Department of Energy (DOE), heating water accounts for up to 14% of the average household's energy use. Solar thermal systems will significantly reduce the amount of electricity or natural gas your household uses to heat water. While the system will cost more upfront to install, it will save money in the long run through reduced utility bills.

In Frederick County, solar thermal systems typically range in size from two 4'x8' collectors heating an 80 gallon tank, to three 4'x8' collectors heating a 120 gallon tank. They cost approximately $8,400 to $9,600, respectively, before incentives. The Maryland Residential Clean Energy Grant, the federal tax credit, the sale of Solar Renewable Energy Credits, and electricity savings can reduce first year costs by as much as $4,000. (Source: Sustainable Energy Systems, personal communication.)

Many installers offer a free site assessment and estimate, handle local permits and inspections, assist you with applying for grants and tax credits, and refer you to brokers for the sale of Solar Renewable Energy Certificates (SRECs). Be sure to ask about these services in advance.

Take Action:

Request a home assessment from a solar thermal installer. Refer to *Appendix C: Contractor Selection Tips and Resources* on page 47 to find and assess prospective installers.

1. Install a solar thermal system.
2. Apply for the Maryland Residential Clean Energy Grant[18] and the Federal Renewable Energy Tax Credit[19]; arrange for the sale of SRECs.

For more in-depth information, turn to *Chapter 3: Solar Thermal (Hot Water) Systems* on page 23.

Photo courtesy of Sustainable Energy Systems, LLC

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GREEN POINTS 20

8. Install solar photovoltaic (PV) panels. Purchase, lease, or enter into a Power Purchase Agreement (PPA) for a system on your home or property.

Solar photovoltaic systems consist of solar modules or panels that convert sunlight directly into electricity. Modules are connected to an inverter which converts the direct current produced by the modules into the alternating current that is identical to the power we receive from the grid. To be effective, rooftop or ground-mounted systems should face south or southwest with little or no shading.

Because sunlight is intermittent, most systems are grid-connected, net-metered systems. When the sun is shining and the system is producing more energy than the building and its occupants are using, the excess energy flows back onto the electric grid and the meter "runs backward" providing a net credit to the homeowner.

When the system is not generating enough electricity to meet the needs of the building, the homeowner can utilize regular grid-supplied power as needed.

Solar PV systems are expensive, but incentive grants, tax credits, and the sale of solar Renewable Energy Certificates can offset the cost of purchased systems. Alternatively, options to lease or enter into a PPA with a solar provider can reduce or even eliminate upfront costs. Installers typically offer a free site assessment and estimate, handle local permits and inspections, and assist you with applying for grants and tax credits.

Take Action:

Request a home assessment from a solar PV installer. Refer to *Appendix C: Contractor Selection Tips and Resources* on page 47 to find and assess prospective installers.

1. Install a solar photovoltaic system.

2. Apply for the Maryland Residential Clean Energy Grant[18] and the Federal Renewable Energy Tax Credit[19]; arrange for the sale of SRECs.

For more in-depth information, turn to *Chapter 4: Solar Photovoltaic Systems* on page 28.

Photo courtesy of Rich Maranto

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GREEN POINTS 15

9. Install a geothermal heating and cooling system.

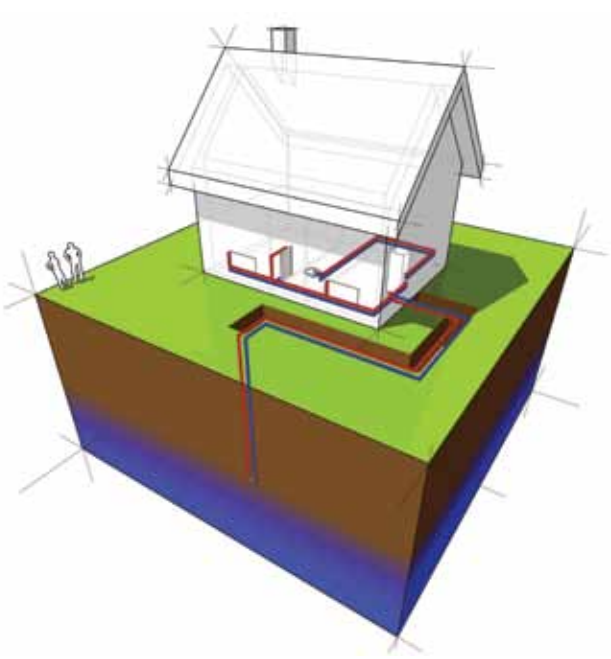
A geothermal Heating, Ventilating and Air Conditioning (HVAC) system uses the temperature of the earth to heat and cool your home. In Maryland, the ground temperature stays at a constant 55°F year round. A geothermal system uses the fact that heat travels to cold to transfer the earth's naturally occurring temperature to a working fluid (glycol). To perform this heat transfer, geothermal systems use piping buried in your yard, installed vertically in wells, or submerged in a nearby pond. During the summer months the heat taken out of the air in your house is transferred to the ground (or pond). The process works in reverse during the winter months, transferring the heat of the ground to the house.

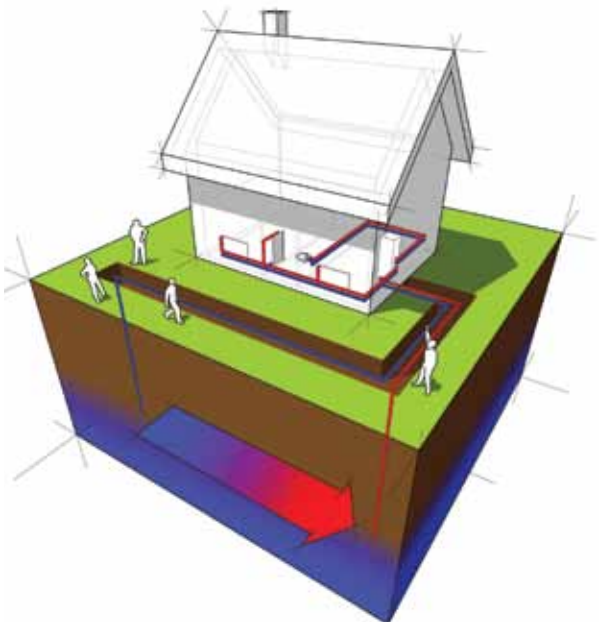
A geothermal system is a major investment. In a typical home of 2,500 square feet, a geothermal system may cost $20,000 - $25,000 to install. While this is roughly double the cost of a conventional HVAC and hot water system, geothermal systems can reduce utility bills by 40% to 60%. Maryland grants and the federal tax credit will typically cover 40% of the total cost of the system; in addition, loan and financing plans are available.

Take Action:

1. Request a home assessment from a geothermal installer. Refer to *Appendix C: Contractor Selection Tips and Resources* on page 47 to find and assess prospective installers.
2. Install a geothermal system.
3. Apply for the Maryland Residential Clean Energy Grant[18] and the Federal Renewable Energy Tax Credit[19].

For more in-depth information, turn to *Chapter 5: Geothermal Heating and Cooling Systems* on page 34.





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GREEN POINTS 20

10. Install a small wind turbine on your property.

Small wind turbines produce electricity from wind; they are mechanically simple, with only two or three moving parts: blades of 2-15 feet in length, a generator located at the hub, and a tail. Small wind turbines can generate clean energy for homes on properties or farms greater than one acre in size with sufficient wind resources. Only about half of Frederick County has sufficient wind to support wind turbines. The western and eastern sections of the county have annual average wind speeds around 4 meters per second and greater at a 30 meter height, which is considered to be a suitable wind resource for small wind projects. Good exposure to prevailing winds is also critical. For large community or agricultural wind turbine installations with an expected capacity greater than 5 KW, Maryland's State Anemometer Loan Program[20] can provide wind measuring devices to property owners.

While most small wind turbines look like miniaturized utility-scale, three-bladed turbines, there are hundreds of models of varying appearance. Like solar PV systems, small wind turbines can be tied to the electric grid allowing the owner to use electricity from the local utility when the wind does not blow, and send surplus electricity to the grid when winds are strong and usage is low. (Sources: American Wind Energy Association[21]; Montgomery County Department of Environmental Protection[22].)

Small wind turbines (3 to 10 kilowatts) can cost from $15,000 to $50,000 to install. The federal tax credit, the Maryland WindSwept Grant Program[23], and utility bill savings can offset the initial outlay considerably.

Take Action:

Request a property assessment from a wind turbine installer. Refer to *Appendix C: Contractor Selection Tips and Resources* on page 47 to find and assess prospective installers.

1. Install a small wind turbine.
2. Apply for the Maryland Windswept Grant[23] and the Federal Renewable Energy Tax Credit[19].

For more in-depth information, turn to *Chapter 6: Small Wind Turbines* on page 39.

GREEN POINTS 1

11. Refer 5 Frederick County households to the Green Homes Challenge.

Help spread the word by referring 5 of your friends, family members, co-workers, or neighbors to the Green Homes Challenge. Motivate them to register online at *FrederickGreenChallenge.org* or complete the paper form available on page 59.

Name

1. _____
2. _____
3. _____
4. _____
5. _____

FREE

GREEN POINTS 2

12. Attend a workshop, seminar, webinar, or discussion about renewable energy.

Would you like to learn more about renewable energy technologies? Attend a Renewable Energy or Solarize Workshop hosted by the Green Homes Challenge team. Check the online schedule at *www.FrederickCountyMD.gov/GreenHomes* or call the Green Homes Challenge Coordinator at 301.600.7414 for dates and times.

You can also attend a workshop, seminar, or discussion on an issue of interest to you hosted by another organization. Some regional organizations that host courses, workshops and seminars related to renewable energy include: The Common Market, Frederick Community College, Hagerstown Community College, and the Green Building Institute.

GREEN POINTS 4

13. Become a Green Ambassador.

If you like the idea of inspiring or motivating others to go green, consider becoming a Green Ambassador for your workplace, faith community, or neighborhood organization! Green Ambassadors empower and support others in their quest to save energy, adopt green lifestyle practices, use renewable energy, and reduce carbon emissions! It is a flexible role with no set time commitment; use the Green Homes Challenge resources and implement your own creative ideas as well. You may serve individually or pair up with another Green Ambassador in your designated network or community. Be creative and have fun!

Green Ambassadors may promote the Green Homes Challenge, distribute resources, help to navigate Challenge Takers through the program, and organize workshops and Powerware Parties. Ambassadors receive training, support materials, and a limited number of mini-grants of up to $500 to support their planned activities.

For more information on becoming a Green Ambassador, turn to page 56.

Earn bonus points.

Has your household completed a renewable energy action that is not included in this handbook? Contact the Green Homes Challenge Coordinator at 301.600.7414 or *GreenHomes@FrederickCountyMD.gov* to tell us about your additional actions and to receive help with assigning an appropriate point value. If you think of a great new action, we may add it to the Challenge!

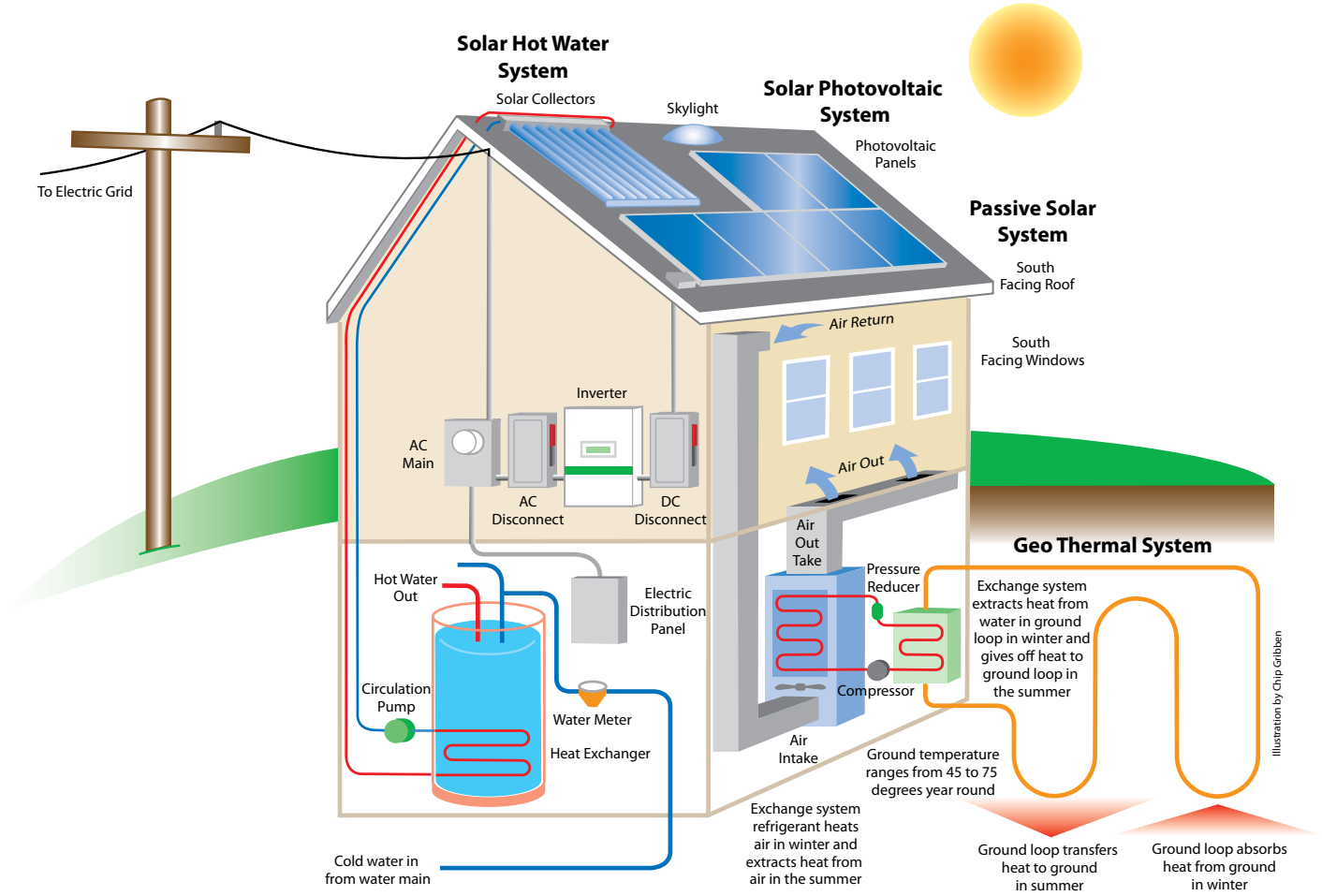
Turn to the Certification Form on page 43 to track the points you've earned and certify.

Renewable Energy Options and Technologies

The following six chapters provide concise summaries of renewable energy technologies and options you can consider for your home. Chapters 1 and 2 give you an overview of utility-scale clean renewable energy. You will learn how energy is tracked and purchased, and how it is supplied to our nation's electric grid, utility companies, and to your home.

Chapters 3 through 6 provide all the information you need to consider renewable energy systems for your home, such as those diagramed below. If you are interested in a solar hot water system, a solar electric system, a geothermal heating and cooling system, or a small wind turbine, these chapters will help you understand how these systems work and make informed decisions.

Check out ***Appendix B: Meet Some Frederick County Renewable Stars*** on page 45 to learn how one family incorporated several renewable energy systems in their home.



CHAPTER 1: Clean Renewable Energy – The Basics

Contributor: Montgomery County Department of Environmental Protection

What Is Clean Renewable Energy?

Clean energy is electricity generated from a renewable resource—such as wind, sunlight, thermal energy stored in the ground, methane from landfills, or sustainable biomass—that emits little or no pollution in the generation process. In contrast, fossil fuels like coal, oil, and gas aren't considered clean because of the pollution associated with their extraction from the earth and with the combustion process used to generate the power. The gases emitted when fossil fuels are burned include air pollutants and greenhouse gases.

Why Clean Energy?

Much of the electricity supplied to American homes today is generated by burning fossil fuels. For example, in 2011 61.66% of Potomac Edison's electricity was generated from burning coal and gas and only 3.44% came from renewable sources[1]. As a result, the average American home that uses standard electricity generates more greenhouse gases and pollution in a year than an average car generates during the same period! For example, based on the 2011 regional fuel mix for electricity generation, if your household used 1,000 kWh of standard electricity in one month, that would result in 1,293 pounds of carbon dioxide, 8 pounds of sulfur dioxide, and 3 pounds nitrogen dioxide being emitted into our atmosphere.

Switching to clean energy sources helps to:

- Reduce pollution and greenhouse gases by reducing the amount of coal, oil, and gas burned to create electricity;
- Boost the renewable energy market and increase regional demand for clean energy;
- Generate new jobs and revenue in clean energy generation, transmission, and installation;
- Encourage innovation in clean energy technology;
- Reduce your personal environmental footprint; and
- Support national security by reducing dependence on foreign countries as sources of oil.

How Much Does Clean Energy Cost?

At present, clean energy supplied by local utilities costs you (the consumer) about the same as "standard" power (electricity generated by traditional sources such as oil and coal). The Maryland Office of the People's Counsel[2] posts up-to-date electricity rates for suppliers serving the Potomac Edison Service area. Rates for clean energy, while very similar to Potomac Edison standard rates, vary slightly depending on how long your contract is and whether you opt for clean energy that is generated regionally or from other parts of the country. Note that the prices for clean energy and standard power will fluctuate over time, so it is a good idea to check the rates of suppliers periodically.

How Do I Buy Clean Energy?

The energy market in Maryland is deregulated, so you can choose your energy supplier and the type of energy you want to buy. If you haven't already entered into a contract with a competitive electricity supplier, you can switch suppliers today. If you already have a contract, be sure to check it before you switch products or suppliers! To avoid penalties, you might have to wait until your current contract expires to change suppliers.

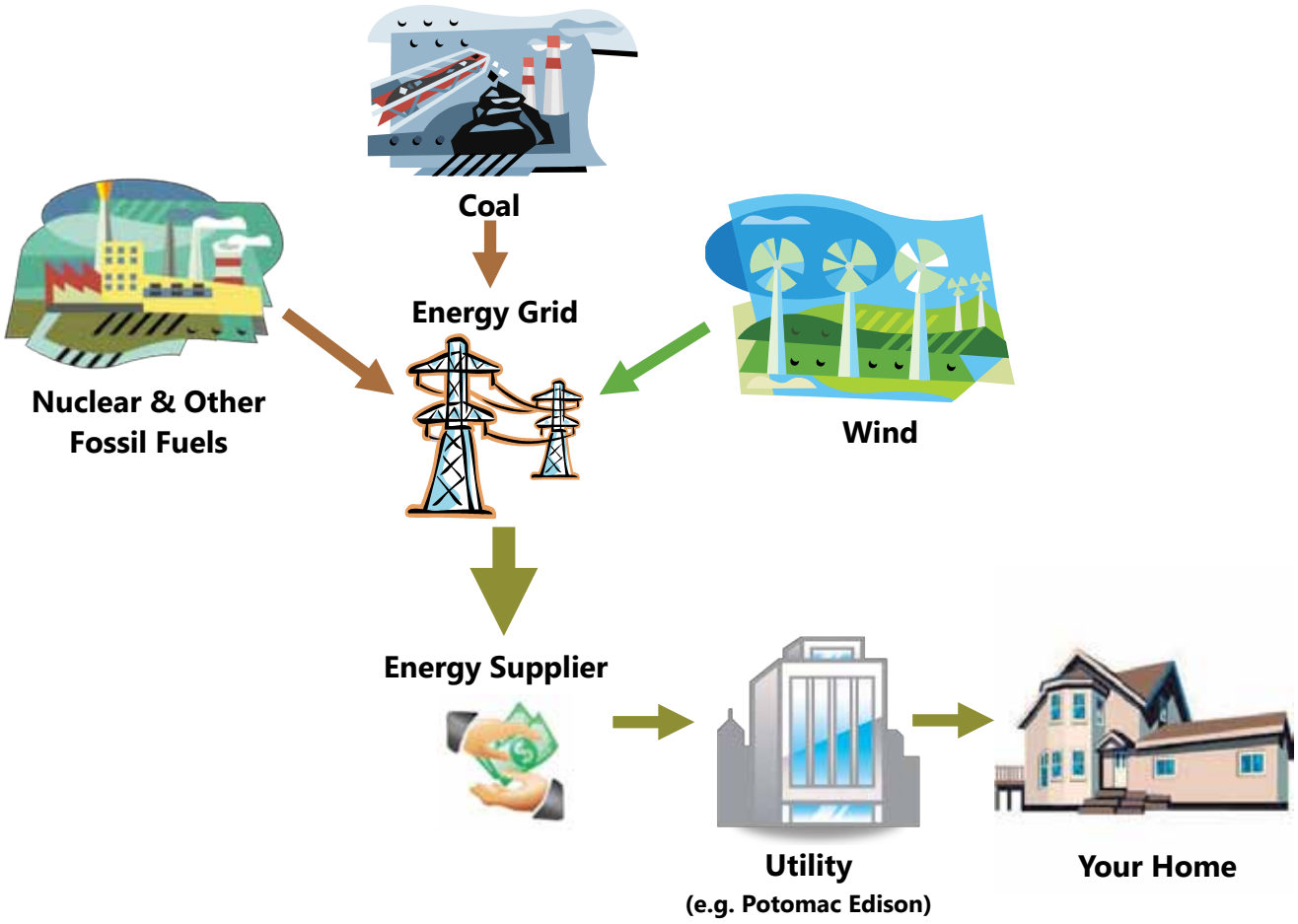
Once you have chosen a supplier, you can buy clean energy online. All you need is your utility account number and your address, and you can sign up for clean energy through the supplier's website. The supplier will contact you by mail to confirm the change.

Learn more about energy deregulation and choosing an energy supplier through the Maryland Attorney General's web site[24].

How Does Clean Energy Get to My Home?

You don't need to install special equipment to receive clean energy. By choosing a competitive energy supplier, you choose to buy a percentage or all of your electricity from clean energy sources like wind or solar. This clean energy is delivered to your house by your local utility in the same way it provides regular energy.

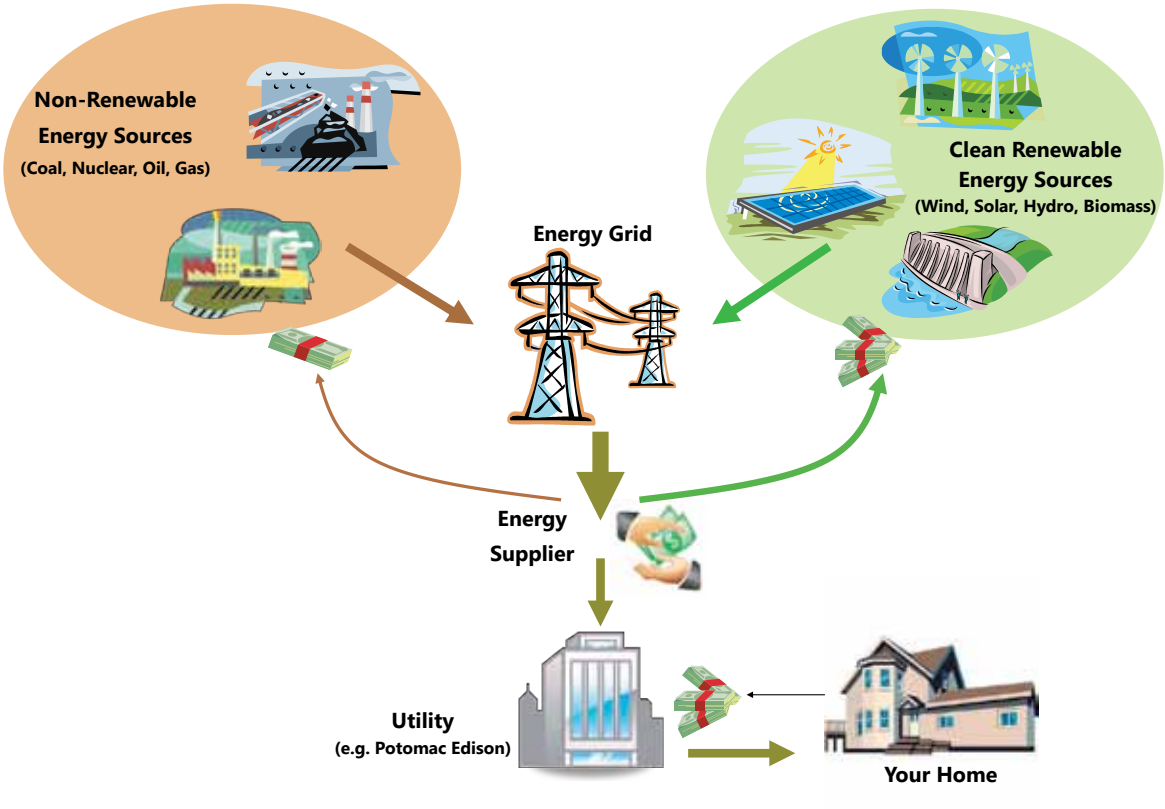
The diagram below shows how energy moves from energy generators to your home. Electricity generated from nuclear, coal, wind, and other sources is transferred to the energy grid. Your local utility company (Potomac Edison) or your clean energy supplier purchases power from the electricity generators. This electricity is transmitted through the grid to your geographic area and the utility company distributes it to your home.



Energy moves from energy generators to your home through the energy grid.

Though some of the energy available in the grid was generated using a renewable resource, this clean energy can't be distinguished from the millions of other electrons flying through the wires to reach your home or business. The electricity grid is like a big pool being filled with water from many hoses. The hoses are the different types of energy sources—coal, nuclear, wind, solar, etc. Once the water is in the pool, you can't tell which hose it came from; once the electricity is in the grid, you can't identify its source.

Energy suppliers can influence how much energy is transferred to the grid from each source by selectively purchasing energy from different generators. If, for example, an energy supplier purchases more energy from a generator that produces electricity from a renewable source, such as wind, more of the electricity available in the energy grid will come from a clean energy source (as shown in the figure below).



Energy suppliers influence the types of energy supplied to the grid.

By purchasing clean energy through a competitive energy supplier, you're creating a market for renewable energy and causing energy suppliers to purchase more energy from clean energy generators. You're directly affecting the amount of clean energy available in the grid and supporting energy generators that produce sustainable, renewable energy!

CHAPTER 2: Renewable Energy Certificates

Contributor: Montgomery County Department of Environmental Protection

What Is a Renewable Energy Certificate (REC)?

Renewable energy certificates (RECs), also known as "green tags", quantify the amount of clean energy a generator has produced from a clean, renewable source (such as wind or solar) and transmitted to the power grid. The generator accounts for the clean energy transmitted by assigning a unique "certificate," green tag, or number to each megawatt-hour (1,000 kilowatt-hours) of electricity generated. The generator uses the certificates to account for how much clean energy was produced and how much clean electricity utilities and consumers can buy.

RECs also represent the environmental benefits of clean energy generation. The environmental benefits are the emissions avoided because electricity was produced from a clean energy source instead of from a standard fuel source such as coal, oil, or gas. For instance, RECs represent the pounds of carbon dioxide, sulfur dioxide, and nitrogen oxides that were not emitted due to the burning of fossil fuels. Purchasing RECs allows a household, business or organization to offset the pollution that results from their use of electricity generated by burning fossil fuels.

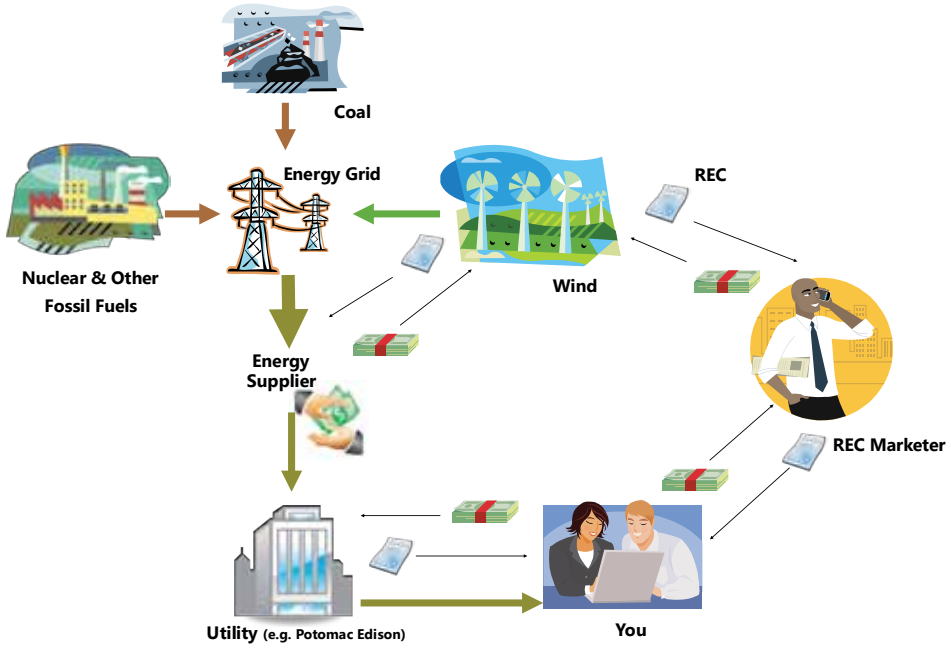
RECs can be sold by the clean energy generator in one of two ways:

1. Sell the electricity and the REC to a utility or energy supplier that resells both as clean energy to a consumer. This is what happens when you purchase renewable energy through your utility (See Action 1 on page 7).

2. Sell the REC to a REC Marketer, who resells the REC (without the electricity) to a consumer who is interested in offsetting pollution and supporting clean energy generators (See Action 2 on page 8).

The diagram below shows how RECs from clean energy generators can be sold to energy suppliers or REC Marketers and then to the consumer (you). When you buy clean energy from an energy supplier, the supplier passes the REC on to you with electricity service. When you buy a REC through a REC Marketer, you're just purchasing the environmental benefit of the clean energy without electricity service. This flexibility allows even those who do not directly communicate with their energy suppliers or negotiate their lease conditions (such as businesses, congregations, condominium owners, or renters) to offset the pollution from the fossil-fuel-sourced electricity they buy and use.

Remember: If you are purchasing RECs along with energy from a utility, it is important to realize that you are not getting the exact electricity that was generated from the clean energy source. The energy you receive is pulled from the energy grid, which stores energy from many sources across the country. The REC represents credit for the clean energy you helped bring to the grid and the environmental benefit of that clean energy generation.



Why Buy RECs?

About 38% of the greenhouse gases produced in the United States comes from electricity generation (See *EPAs 2009 Inventory of Greenhouse Gas Emissions and Sinks: 1990-2010*[25] for more information).

Purchasing RECs supports more clean energy production which helps decrease the amount of electricity generated from fossil fuels. Money generated from the sale of RECs can help fund clean energy projects. Electricity generated from renewable sources can be inexpensive to produce, but getting started can be challenging and expensive. There are government subsidies and tax breaks that support renewable energy generation projects. The sale of RECs gives clean energy generators more flexibility in covering the costs of clean energy projects.

Purchasing RECs also helps balance the supply and demand for clean energy. There is not always a demand for clean energy where it is produced, and some energy suppliers do not offer clean energy options. However, there might be a demand to support clean energy elsewhere. By separating the environmental benefits of clean energy generation from the actual electricity, the generator can get a fair market price for its electricity and help consumers elsewhere offset the emissions associated with their electricity use.

These are several great reasons to purchase RECs. But here's the icing on the cake: **Buying RECs is an easy way to reduce your environmental footprint without a large financial commitment.** It's just not always possible to buy a new, fuel-efficient car or undertake a home improvement project, but it's easy to make a purchase supporting cleaner energy generation.

How Do I Buy RECs?

You can purchase RECs from a REC marketer; review options at the U.S. Department of Energy (DOE) Green Power Markets webpage[3]. Depending on the REC Marketer, RECs can be a one-time purchase or can be purchased in monthly installments. Each REC Marketer offers a variety of product options. Several businesses sell RECs online. Some companies send a certificate verifying your REC purchase; others send a letter.

Shop around and find the type of REC (wind, solar, a blend of clean energy generation sources) and the Marketer that is in line with your goals for purchasing clean energy. For instance, is there a specific type of clean energy you want to support? Do you want to support clean energy that is generated in your region or somewhere else in the country?

How Much Do RECs Cost?

It depends. The per-unit price of a REC depends on the type of clean energy generated (wind, solar, sustainable biomass), where the clean energy was generated, and how many RECs you want to purchase. For instance, wind RECs from the Midwest or Texas, where there is an abundant supply of wind energy, may cost 1.5 cents per kilowatt-hour and may be less expensive than solar RECs from the Mid-Atlantic where the solar industry is just starting to gain a foothold. REC Marketers sell renewable energy certificates from all types of clean energy generators so you can choose the type of clean energy you want to support as well as the location. Current prices from REC marketers can be found on DOE's Green Power Markets web pages[3].

How Many RECs Should I Buy?

When you purchase RECs, you can buy RECs equivalent to any amount of your total electricity use. Buying RECs in an amount that equals 100% or your electricity use allows you to offset all of the emissions, or you could choose to offset a portion of your electricity use. Regardless of how many you decide to purchase, as a REC consumer, you are supporting the addition of clean electricity—and its environmental benefits—to the power grid.

You can estimate the number of RECs to purchase using your electric bill. Find the "Usage History" on the bill and use the "Last 12 Months Use" or take the "Average Monthly Use" and multiply it by 12 to get an estimate of your annual energy use.

Who Benefits from the Purchase of RECs?

We all do! Your choice to switch to clean energy helps decrease our impact on the environment. According to the Center for Climate and Energy Solutions, the United States, with only 5% of the world's population, produces 25% of global greenhouse gas emissions. Clean energy, combined with energy-efficient technologies, is one of the several solutions to help decrease the amount of pollution we release into our environment and protect our planet for future generations.

CHAPTER 3: Solar Thermal (Hot Water) Systems

Contributors: Montgomery County Department of Environmental Protection[26]; Curtis Nelson, NPC Solar; Zayn Bradley, Sustainable Energy Systems

What They Are and How They Work[26, 27]

Solar hot water systems, also known as solar thermal systems, use solar collectors to absorb the sun's light and change it into heat energy. Solar collectors heat a fluid, which is then used to provide either hot water for household use or heat for the home. Some thermal systems produce warm water that is used to heat swimming pools.

Solar domestic hot water systems use the sun to heat either water or a heat transfer fluid, such as a water-glycol antifreeze mixture. This is done in collectors which are usually mounted on the roof. Once the water is heated, either directly or via heat transfer, it is stored in a tank similar to a conventional gas or electric water heater tank.

With direct circulation systems, pumps circulate household water through the collectors, where it is directly heated by the sun, and then into the home to be used for bathing, laundry, etc. This design is also known as "open-loop" and it works well in climates where freezing temperatures are rare.

With indirect circulation systems, an electric pump circulates a heat transfer fluid through the collectors. The fluid absorbs heat from the solar collector and then passes through a heat exchanger. The heat exchanger, which generally is in the water storage tank inside the house, transfers heat to the water. In this case, water is indirectly heated by the sun; such designs are also called "closed-loop" systems. These are popular in locations where freezing temperatures are common.

In addition to there being two types of circulation systems, there are also two main types of solar collectors for indirect circulation systems that are suitable for Frederick County's climate:

Photo courtesy of Dawn & Curtis Nelson

Evacuated-Tube Collectors consist of rows of parallel transparent glass tubes, in place of the absorber plate in a flat-plate collector. The absorber tubes are cylindrical in shape; therefore, the angle of the sunlight is perpendicular to the absorber for most of the day. This enables these collectors to perform well even when sunlight is diffuse, and in areas with cold, cloudy winters. Because air is evacuated from the space between the tubes, the resulting vacuum minimizes heat loss to the outdoors and makes the collector more efficient. As a result, evacuated-tube collectors usually heat water to fairly high temperatures. While they can achieve higher temperatures and efficiencies than flat-plate collectors, they are also more expensive.

Photo Credit: By SolarCoordinates (Own work) [CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

Flat-Plate Collectors are the most common collector for residential water-heating and space-heating installations. A typical flat-plate collector consists of an insulated metal box with a glass or plastic cover, called "glazing," and a dark colored absorber plate. Sunlight passes through the glazing and strikes the absorber plate, which heats up, changing solar radiation into heat energy. The glazing allows the light to reach the absorber plate but reduces the amount of heat that can escape. The heat energy produced in the collector is used to heat the liquid (either water or a heat transfer fluid) as it flows through tubes, in or adjacent to the absorber plate.

Siting a Solar Hot Water System

The Department of Energy (DOE) provides an excellent web page on *Siting Your Solar Water Heating System*[28]. While an obstruction-free southern exposure is best for optimal results, depending on your location and the tilt of your collector, your system can face up to 90 degrees east or west of true south without significantly decreasing its performance. You will need to assess your site's solar resource and the optimal orientation and tilt for your solar collector. The efficiency and design of your system will depend on how much of the sun's energy reaches your roof or property (if the system will be ground-mounted). In addition, both the orientation and tilt of the collector will affect your solar water heating system's performance. The optimal tilt for your solar thermal collector is an angle equal to your latitude; however, installing your collector flat on an angled roof should not result in a big decrease in performance.

Solar thermal suppliers and installers can perform a solar site analysis for you, usually at no charge. Refer to ***Appendix C: Contractor Selection Tips and Resources*** on page 47 to find and assess prospective installers.

Costs of a Solar Hot Water System[29]

Solar water heating systems typically cost more to purchase and install than conventional water heating systems. A solar water heater can, however, save you money in the long run. In Frederick County, solar thermal systems typically range in size from two 4'x8' collectors heating an 80 gallon tank, to three 4'x8' collectors heating a 120 gallon tank. They cost approximately $8,400 to $9,600, respectively, before incentives. (Source: Sustainable Energy Systems, personal communication).

Understanding the Incentives

The information below on incentives is current as of February 2013. For the most up to date information on incentives, visit *www.DSIREUSA.org*.

The Maryland Residential Clean Energy Grant[18], the federal tax credits[19], the sale of Solar Renewable Energy Credits, and electricity savings can reduce first year costs by as much as $4,000.

1. **State Grant:** The Maryland Residential Clean Energy Grant Program currently offers a $500 flat incentive for systems with a panel area of 10 - 100 square feet.
2. **Federal Investment Tax Credit:** Under current law, solar hot water systems installed prior to December 31, 2016 are eligible for a 30% federal tax credit. At least half the energy used to heat the dwelling's water must be from solar.
3. **Solar Renewable Energy Credits (SRECs):** A Solar Renewable Energy Credit (SREC) is a tradable commodity representing the non-polluting value of 1,000 kWh (1 Megawatt hour (mWh)) of electricity (or the equivalent) produced by a solar system. A solar thermal system contractor may install a controller that converts British thermal units (Btu) to kilowatt hours (kWh) in order to track the accumulation of equivalent kilowatt hours. A 30-tube evacuated tube system can be expected to produce 3 mWh, or 3 SRECs per year, which in 2012 was worth approximately $420.

   System owners have several options for selling their SRECS:

   - A system installer may refer new owners of solar thermal systems to an SREC aggregator/broker who may process required paperwork and trade SRECs on their behalf. This may be the simplest option for homeowners who do not want to be directly involved with extra paperwork and the selling of SRECs.
   - System owners may register and sell their SRECs themselves by applying for certification through the Public Services Commission's website[30] and by setting up an account and registering their system with the Generation Attribute Tracking System[31] (GATS). GATS is where SRECs are created, tracked, and transferred to buyers when sold. GATS allows users to report generation data and collect and advertise credits for sale via the GATS Bulletin Board.
   - System owners may register their system with an auction platform, such as SREC Trade, Inc.[32], which provides public listings of SREC pricing and hosts monthly auctions for SRECs. Alternatively they can register with a trading platform, such as Flett Exchange[33]; it also tracks the kilowatt hour generation of its customers' systems, and pays customers the current rate for the annual SRECs their systems produce.

Pro-Formas – Costs and Payback over 5 Years

The charts below compare the costs and impact of incentives on evacuated tube and flat plate systems:

Pro-Formas* Evacuated Tube Systems	A. 30 Tube, 2" double-walled tubes; sized for 2-4 people (~36,000 Btu)	B. 24-Tube; 4" Single walled tubes; sized for 4-5 people (~52,000 Btu)	C. 60-Tube, 2" double-walled tubes; size for 5-7 people (~72,000 Btu)
Installed Cost	$9,000	$12,000	$14,000
MD State Grant	$500	$500	$500
Federal Tax Credit	$2,700	$3,600	$4,200
Electricity Savings (Year 1)**	$504	$756	$1,008
SREC sale (1 SREC = $140) 5 max per year***	$420	$700	$700
Total Grants/Credits/Savings (Year 1)	$4,124	$5,556	$6,408
Net Cost to System Owner (Year 1)	$4,876	$6,444	$7,592
Years 2-5 Electricity Savings**	$2,016	$3,024	$4,032
SREC 5-yr average***	$1,680	$2,800	$2,800
Maintenance (Replacing Glycol at year 3-5)	$300	$300	$300
Net Cost to System Owner (Year 5)	**$1,480**	**$920**	**$1,060**

Pro-Formas* Flat Plate Collectors/Drainback	A. 40 sq. ft. sized for 2 people (25,739 Btu)	B. 64 sq. ft; sized for 2-4 people (35,849 Btu)	C. 80 sq. ft; sized for 4-7 people (41,280 Btu)
Installed Cost	$7,800	$8,600	$9,400
MD State Grant	$500	$500	$500
Federal Tax Credit	$2,340	$2,580	$2,820
Electricity Savings (Year 1)	$299	$417	$479
SREC sale (1 SREC = $140) 5 max per year	$420	$560	$658
Total Grants/Credits/Savings (Year 1)	$3,559	$4,057	$4,457
Net Cost to System Owner (Year 1)	$4,241	$4,543	$4,943
Years 2-5 Electricity Savings	$1,196	$1,667	$1,916
SREC 5-yr average	$2,100	$2,800	$3,290
Maintenance (Replacing Glycol at year 3-5)	$0.00	$0.00	$0.00
Net Cost to System Owner (Year 5)	**$945**	**$76**	**-$263**

*For illustrative purposes only. A Pro-forma is assumed, forecasted, or informal information. It gives an idea of how the actual finances may look if underlying assumptions hold true. Actual costs and incentives depend upon site conditions and programs that may or may not be applicable to your situation. These pro-formas are not guaranteed and are subject to change without notice. Pro-formas for evacuated tube systems provided by NCP Solar; pro-formas for flat plate collectors provided by Sustainable Energy Systems.

** Electricity costs assume $0.10 per kWh in all years

***Assumes 1 SREC = $140.

You may want to consult with one or more solar thermal installers and compare the estimated annual operating and maintenance costs of several solar water heaters. Such comparisons can help you decide if it is worth investing in a more efficient system.

The pro-formas above illustrate that the payback period for solar thermal systems may be approximately five to six years based on stated SREC and electricity cost rates. Both the payback period and the return-on-investment (ROI) will vary depending on the cost of the system and the actual price of electricity and value of SRECs over time. If you do not plan to live in your home for the life of your system, you should be careful to calculate payback periods and ROIs using best and worst case scenarios. Your installer may be able to assist with this. Also note, Maryland Statutes and Codes prevent any increase in real property taxes due the installation of solar hot water systems.[34]

Paying for a Solar Hot Water System

If the initial cost of a solar thermal system is an obstacle for your household, the energy and utility bill savings attributable to the system can become a source of funds for making monthly payments on a bank or home equity loan. Alternatively, as of the date of this handbook printing, the *Maryland Be SMART Home Complete*[35] loan program was offering up to $15,000 in unsecured loans at an interest rate of 4.99% for energy efficiency upgrades that include solar thermal systems. This program includes a home energy audit and does require using the program's approved contractors. They have a limited number of contractors for renewable energy systems; however, contractors can be added on a rolling basis. In addition, the FHA's *PowerSaver Program* allows eligible owners to borrow up to $25,000 at fixed rates to finance energy efficiency projects and renewable energy projects like solar hot water systems. Enter "FHA PowerSaver Program" into your internet browser to learn more.

According to the U.S. Department of Energy's web page on *Estimating the Cost and Efficiency of a Solar Water Heater*[29], a solar water heater can result in your water heating bills dropping 50%–80%. The amount of savings you might expect depends on the following:

- Family size and how much hot water you use;
- How well your system performs;
- Your geographic location and the extent of solar resources;
- Available financing and incentives; and
- The cost of conventional fuels (natural gas, oil, and electricity).

Because the sun is a free energy source, a solar thermal system may also protect you from future fuel shortages or price increases.

If you are building a new home or refinancing your current home, the economics of purchasing a solar hot water system can be very appealing. If you include the cost of a solar water heater in a 30-year mortgage, it may amount to between $13 and $20 more on your monthly payment; however, the federal income tax deduction for mortgage interest attributable to the solar system reduces that by approximately $3–$5 per month. Therefore, if your fuel savings are greater than $15 per month, the solar investment is profitable right away because you are saving more than you are paying each month.

Deciding if a Solar Hot Water System is Right for You

A solar hot water system makes the most sense if you can answer yes to the following questions:

1. Do you own your house and expect to remain there for a long time (more than 5 – 8 years)?
2. Is your roof in good condition or do you have an area suitable for a ground-mounted system near the house?
3. Does the location of your solar thermal system provide for good exposure to sunlight in a southerly direction?
4. Will the solar collectors not be significantly affected by shading from trees or other obstructions?
5. Do you have cash available to pay for the system upfront or are you willing to apply for a loan?

Although a negative answer to one or more of these questions does not necessarily mean that a solar hot water system is inappropriate for a property, it does suggest that it may be more difficult to maximize the value of the system or that the financial benefits may be limited.

Installation and Maintenance: Requirements and Expectations

Several permits and inspections (electrical, plumbing, etc.) are needed when a solar hot water system is installed. Additional permits/inspections are needed for ground-mounted systems. Many installers will take care of these steps for you and roll the permit and inspection fees into their estimate and contract. Be sure to ask about this when you get you cost estimates.

If your contractor does not handle these requirements for you, depending on where you live, you will need to check with your municipality or Frederick County Government about the permitting and inspection processes and fees. DOE provides a good list of things to consider on their *Building Codes and Regulations for Solar Water Heating Systems* web page[36].

The entire project may take three to four weeks from start to finish, though installation of the system itself will only take three days to a week. Receipt of the $500 Maryland Residential Clean Energy Grant can take up to a month. Following installation, maintaining your system is important to keep it running smoothly. Be sure to discuss the maintenance requirements and options with your installer or system provider. DOE's web page on *Solar Water Heating System Maintenance and Repair*[37] provides a good list of do-it-yourself inspections and other recommendations.

Photo courtesy of Dawn & Curtis Nelson

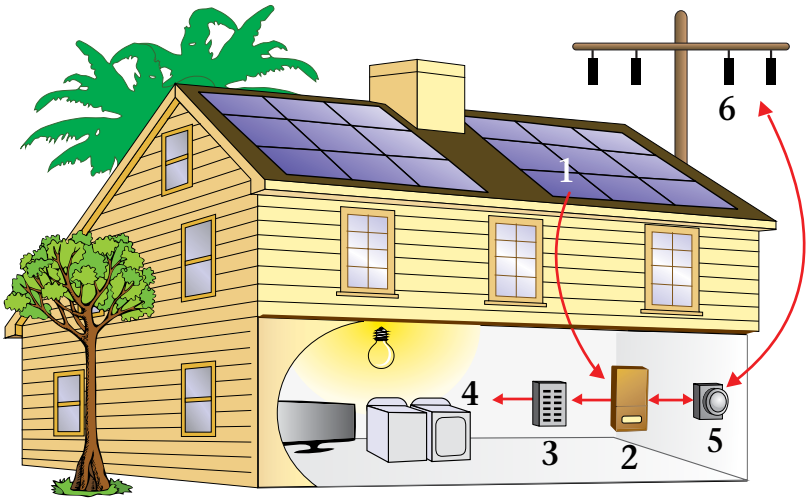
Chapter 4: Solar Photovoltaic (PV) Systems

Contributor: Fred Ugast, U.S. Photovoltaics, Inc.

What They Are and How They Work

Photovoltaic (PV) systems consist of solar modules or panels that convert sunlight directly into electricity. Each module consists of solar cells made of semiconducting materials like silicon which release electrons when struck by sunlight creating an electric current. Multiple modules are connected in series to an inverter which converts the direct current produced by the modules into the alternating current that is identical to the power we receive from the electrical grid.

Since sunlight is an intermittent resource, most systems in Maryland are grid-connected, net-metered systems. When the sun is shining and the system is producing more energy than the building and its occupants are using, the excess energy flows back onto the grid for use by other utility customers. In this situation, the systems owner's meter "runs backwards" providing a net credit to the homeowner at the same rate being paid for grid-supplied power. When the system is not generating enough electricity to meet the needs of the building load, the homeowner can utilize regular grid-supplied power as needed. This process is completely undetectable to the building owner and occupants who can only tell whether they are using solar energy or grid-supplied energy by looking at their utility meter.



Graphic courtesy of SolarDirect.com.

1) Solar Electric or PV modules convert sunlight to electricity. The PV modules generate DC electricity - or direct current - sending it to the inverter. (2) The inverter transforms the DC power into AC electricity for ordinary household needs. (3) Existing electrical panel distributes solar electricity and utility power to (4) loads (appliances). A valuable feature of photovoltaic systems is the ability to connect with the existing power grid which allows owners to sell excessive electricity back to the utility with a plan known as (5) Net Metering. At times when you are not using all of the electricity produced by your system, your meter will spin backwards selling the electricity back to the (6) utility power grid at retail rate.

Due to safety regulations, grid-tied PV systems automatically shut down during power outages. If continued power is essential for your household, consider investing in an uninterruptible power supply (UPS) or generator. You can also install a grid-tied system with a battery backup; this will, however, increase installation costs and maintenance while decreasing overall performance efficiency[38].

Solar PV systems are sized by a design capacity measured in kilowatts (kW or 1,000 watts). A system's capacity is equivalent to the number of solar panels multiplied by the maximum design wattage of each panel. Most residential-scale panels range from 150 watts to over 300 watts and the number of panels is limited only by the roof or available mounting area. Generally, a system should be facing south or southwest with little or no shading from trees or other obstructions and placed to receive as much direct sunlight as possible over the course of a year.

Solar panels generally include warranties for power production and include a guarantee that the panels will be producing at least 80% of their design capacity for 25 years. The modules themselves have no moving parts and may continue to produce significant amounts of electricity for 30 years or more. The long-life of the panels, as well as labor cost to install them, also means that they should generally not be installed on a roof that is likely to need replacing in the near future.

The inverter is the only major element of the system that is likely to need replacing at some point. Inverter warranties of 10-15 years are common but generally are not expected to last for the useful life of the system.

The first step in determining how large of a system to install is to look at the historical usage of a home or building as shown on previous electric bills. Although the capacity of a system is measured in kilowatts, the actual electricity generated and used is measured in kilowatt-hours (kWh,) which are a measure of the flow of electricity and a function of the amount of sunlight that actually strikes the panels. In the mid-Atlantic, one kW of solar capacity will generate about 1,200 kWh of solar electricity in an average year. So a home that uses 12,000 kWh per year according to its electric bills would need about 10 kW of solar modules to generate 100% of its electricity needs over the course of a year.

A rule of thumb is that approximately 100 square feet (SF) of roof space is required for enough panels to equal 1 kilowatt of solar capacity, so a 10 kW system would require 1,000 SF of unshaded south or southwestern facing roof space. Although, solar systems can be installed facing east or west, the reduced performance may limit the cost-effectiveness of such systems.

Photo Credit: By Positivefootprint (gary chamberlain) [CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0) or GFDL (http://www.gnu.org/copyleft/fdl.html)], via Wikimedia Commons

Costs of a Solar PV System

Many people choose to install solar PV systems because of the environmental benefits, but the financial payback is also critical to many. Although the cost of solar electricity has been declining rapidly, the cost of installing a solar system continues to be a barrier for many people. However, local, state and federal incentives can reduce the upfront costs significantly and some installation companies are now offering leases and power purchase agreements that reduce or eliminate the upfront costs.

The cost to install a solar PV system declined dramatically over the last several years as the price of solar modules has fallen. Installed costs and components are usually expressed as dollars per watt of DC capacity. PV modules that cost a solar contractor $4.00 per watt a few years ago were frequently available at prices under $1.00 per watt in 2012. Unfortunately, solar modules only represent a portion of the costs of installation. The costs for labor, permits, incentive paperwork, administration and overhead have not significantly declined (and in some cases increased). Nevertheless, installed systems which might have cost $8.00 per watt in 2008 and $6.00 per watt in early 2010 were available for less than $5.00 per watt in 2012. Generally speaking, larger systems cost less per watt than smaller systems because the fixed costs represent a relatively high percentage of the cost of smaller systems.

In addition to the declining installation costs, the available local, state and federal incentives often bridge the gap between the costs of solar electricity and conventional power. These incentives are generally designed to accelerate the adoption of solar in the short-term and are expected to decline and phase out as the realization of grid-parity approaches.

Financial Incentives for Maryland Residential Photovoltaic Systems

The Information below on incentives is current as of January 2013. For the most up to date information on incentives, visit *www.DSIREUSA.org*.

1. **State Grant:** The Maryland Residential Clean Energy Grant Program offers a solar grant of $1,000 for the installation of a solar system on a residence and up to $6,000 on a business property at the rate of $60 per kW for systems under 100 kW and $30 per kW for systems from 100-200kW[18].

2. **Federal Investment Tax Credit:** Under current law, solar PV systems installed on residences or businesses prior to December 31, 2016 are eligible for a 30% federal tax credit[19]. A homeowner or business owner who installs a $30,000 solar PV system can reduce their tax obligation by $9,000 for the tax year in which the system is installed. If the credit is larger than their tax bill in the year of installation, the remainder of the credit can be carried forward to future years.

3. **Solar Renewable Energy Credits (SRECs):** A Solar Renewable Energy Credit (SREC) is a tradable commodity representing the non-polluting value of 1,000 kWh of electricity produced by a solar system. The SREC is separate from the value of the electricity itself and permits the owner or purchaser to claim the benefits of the clean energy production by effectively subsidizing the cost of the installed system. Any company in Maryland that sells electricity must produce the required amount of solar electricity from its own assets. If it cannot, it can purchase SRECs from PV system owners, or pay an Alternative Compliance Fee (ACP) into a fund that will be used to support the construction of solar systems in the state.

Maryland's solar requirement took effect in 2008 requiring approximately 2,500-megawatt hours of solar electric production or 2,500 SRECs. In 2013, the requirement is approximately 150,000 SRECs[39]. The amount of solar electricity required to be produced will increase steadily each year until 2020 at which time solar electricity should account for a full 2% of all the electricity consumed in Maryland—representing more than 1 million MWh (and SRECs) per year.

While it is hard to predict changes in the prices of SRECs, a five kW system could be expected to earn approximately six SRECs per year which may be worth $600 to $1,200 per year for the next several years based on recent values $100-$200. Prices could, however, increase or decrease substantially depending on what the legislature does or if installation costs continue to fall, among other variables. For more in depth explanation of RECs, refer to Chapter 2.

System owners can qualify to earn and then sell their SRECs; they have several options for selling their SRECS:

- A system installer may refer new owners of solar thermal systems to an SREC aggregator/broker who may process required paperwork and trade SRECs on their behalf. This may be the simplest option for homeowners who do not want to be directly involved with extra paperwork and the selling of SRECs.
- System owners may register and sell their SRECs themselves by applying for certification through the Public Services Commission's website[30] and by setting up an account and registering their system with the Generation Attribute Tracking System[31] (GATS). GATS is where SRECs are created, tracked, and transferred to buyers when sold. GATS allows users to report generation data and collect and advertise credits for sale via the GATS Bulletin Board.
- System owners may register their system with an auction platform, such as SREC Trade, Inc.[32], which provides public listings of SREC pricing and hosts monthly auctions for SRECs. Alternatively they can register with a trading platform, such as Flett Exchange[33]; it also tracks the kilowatt hour generation of its customers' systems, and pays customers the current rate for the annual SRECs their systems produce.

Keep in mind that if you decide to sell your SRECs, your household has also "sold" the right to say that your home is being powered by the non-polluting solar PV system on your property. This may matter to some people, but not others.

4. Electricity Savings: The electricity produced by a solar PV system will reduce the amount of electricity required from the grid. In a net-metered system, any production not directly consumed will be transferred to the grid at the full retail value. In calculating the value of the electricity a system will produce over its lifetime, consideration must be given to the expected increases in electricity costs over time. In effect, installing a PV system functions as a pre-purchase of electricity the system will produce over its lifetime.

5. Increased Resale Value: Although many factors other than energy use affect resale value, recent studies suggest that a solar PV system can directly increase the value of a property. One rule of thumb is that a PV system can add 20 times the value of the electricity the system produces on an annual basis. Also note, Maryland Statutes and Codes[34] prevent any increase in real property taxes due the installation of solar PV systems.

Pro-Formas – Costs and Payback over 7 Years

The following table compares the costs and the impact of incentives on different sized systems:

Pro-Formas*:	2 kW	4 kW	8 kW	10 kW
Installed Cost of System	$13,000	$20,000	$32,000	$39,000
Maryland State Grant	$1,000	$1,000	$1,000	$1,000
Federal Tax Credit	$3,900	$6,000	$9,600	$11,700
Sale of Renewable Energy Credits (RECs)**	$320	$800	$1,600	$1,920
Electricity Savings (Year 1)***	$270	$541	$1,082	$1,352
Total Grants, Credits, and Savings (Year 1)	$5,490	$8,341	$13,282	$15,972
Net Cost to System Owner at end of Year 1	$7,510	$11,659	$18,718	$23,028
Years 2-7 Electricity Savings and REC Revenues	$3,359	$6,718	$13,437	$16,796
Net Cost to System Owner at end of Year 7	$4,151	$4,941	$5,281	$6,232
Increased Property Resale Value****	$5,400	$10,820	$21,640	$27,040

* For illustrative purposes only. A Pro-forma is assumed, forecasted, or informal information. It gives an idea of how the actual finances may look if underlying assumptions hold true. Actual costs and incentives depend upon site conditions and programs that may or may not be applicable to your situation. These pro-formas are not guaranteed and are subject to change without notice. Pro-formas provided by U.S. Photovoltaics, Inc.

** Assumes annual sale at 50% of ACP (Alternative Compliance Payment in the Renewable Portfolio Standards law[39]).

*** Assumes $0.11/ kWh in Year 1 and annual increases of 3.5%.

**** Assumes resale value of 20x annual energy savings.

Over the expected 30 year life of the system an owner can expect to save more than $13,000 (2 kW), $27,000 (4.kW) or $55,000 (8 kW) on their electric bill if the cost of electricity increases just 3.5% per year.

The pro-formas above illustrate that the payback period for solar PV systems may be approximately 10 years based on stated SREC and electricity cost rates. Both the payback period and the return-on-investment (ROI) will vary depending on the cost of the system and the actual price of electricity and value of SRECs over time. If you do not plan to live in your home for the life of your system, you should be careful to calculate payback periods and ROIs using best and worst case scenarios. Your installer may be able to assist with this.

Paying For a Solar PV System

A solar PV system is a major investment and a number of alternative financing methods have been developed in recent years that may be appealing to homeowners interested in a solar system but who prefer not to purchase a system outright.

Many installers provide up to 12 months of interest-free financing to permit the homeowner to secure some of the state and federal incentives to reduce the out-of-pocket requirements. Alternatively, homeowners may obtain financing through a bank, credit union, home equity loan, or the *Maryland Be SMART Home Complete* loan program. The *Maryland Be SMART Home Complete*[35] loan program offers up to $15,000 in unsecured loans at an interest rate of 4.99%. This program includes a home energy audit and does require using the program's approved contractors. They have a limited number of contractors for renewable energy systems; however, contractors can be added on a rolling basis. In addition, the FHA's *PowerSaver Program* allows eligible owners to borrow up to $25,000 at fixed rates to finance energy efficiency projects and renewable energy projects like solar PV systems. Enter "FHA PowerSaver Program" into your internet browser to learn more.

In addition, alternatives to purchasing have been developed in recent years that attempt to permit homeowners to gain the benefits of having a solar system without actually buying the system. The most common alternatives to purchasing a system are a lease or a Power Purchase Agreement (PPA). A PPA is very similar to a lease but allows a buy-out option. In both cases, a third-party actually owns the system, pays for its initial installation, retains most or all of the incentives, and is responsible for any maintenance of the system during the term of the agreement.

Traditional leases requiring no upfront payments are available but generally have required payments that exceed the value of grid-delivered electricity at today's prices. Other versions require a significant up-front payment that effectively pre-pays for the electricity the system will produce over the life of the agreement. Paying an entire lease up front will eliminate future payments and allow a homeowner to effectively lock-in the cost of a portion of their future electricity needs at an attractive fixed cost.

There may be several options for the homeowner to pay for the electricity the system produces: (1) paying the entire fixed lease payment for 15 or 20 years, (2) paying one-half of the entire lease payment, or (3) making a regular monthly lease payment based on the actual amount of electricity produced at a specified rate per kWh.

Aside from reducing the amount of capital a homeowner would need to install a solar system, a lease or PPA can provide a more certain payback that is not dependent on the availability and value of some of the incentives which become the property and responsibility of the third-party owner. On the other hand, depending on the specific provisions of the lease or PPA, the bulk of the financial benefits may accrue to the third-party owner, leaving fewer advantages to the homeowner.

Leases and PPAs are generally available only to homeowners with high credit scores and do contain some provisions that may create issues if the homeowner sells the property during the term of the agreement to a buyer that does not meet the criteria required by the third-party owner. Moving leased solar panels to a new home may be an option if the homeowner is willing to pay for the cost of moving and reinstalling the system. Leases and PPAs are still relatively new approaches and it is difficult to know what, if any, effect these provisions will actually have in the future.

Deciding if Solar PV is Right for You

A solar system makes the most sense if you can answer yes to the following questions:

1. Do you own your house and expect to remain there for a long time (more than 7 – 10 years)?
2. Is your roof in good condition or do you have an area suitable for a ground-mount system near the house?
3. Does the location of your solar system provide for good exposure to sunlight in a southerly direction?
4. Will the solar modules not be significantly affected by shading from trees or other obstructions?

Although a negative answer to one or more of these questions does not necessarily mean that a solar PV system is inappropriate for a property, it does suggest that it may be more difficult to maximize the value of the system or limit the financial benefits.

Should I Buy or Lease (or sign a PPA)?

Buying a solar system makes the most sense if:

1. You have cash available or are willing to apply for a loan.
2. You are willing to be responsible for maintenance and repair.
3. You want to maximize the financial benefits through tax credits and SREC sales.
4. You are willing to assume the risks of incentives, such as the value of SRECs, being worth less than expected.
5. You want to be able to claim that your home is powered by your own non-polluting solar PV system (in which case you would not sell your SRECs for the financial benefits).

Leasing or signing a PPA for a solar system makes the most sense if:

1. You have limited cash available or are unwilling to apply for a loan.
2. You have a high credit score (generally >700).
3. You want to minimize responsibility for maintenance and repair.
4. You are willing to be obligated for the term of the Agreement (usually 15-20 years).
5. You are willing to accept the risk that if you sell the house before the term expires, there may be complications or expenses.
6. You are not concerned about the fact that you do not personally own the SRECs for your PV system, and therefore cannot claim, as your own, the non-polluting benefits of your system.

Installation and Maintenance: Requirements and Expectations

It is a good idea to get quotes from more than one contractor. Refer to ***Appendix C: Contractor Selection Tips and Resources*** on page 47 to find and assess prospective installers. Make sure the bids are for comparable systems in size and type so it is easier to make cost and performance comparisons. The U.S. Department of Energy's (DOE) web page on *Installing and Maintaining a Home Solar Electric System*[40] provides some excellent questions to ask contractors.

Several permits and inspections are needed when a solar PV system is installed. Additional permits/inspections are needed for ground-mounted systems. Many installers will take care of these steps for you and roll the permit and inspection fees into their estimate and contract. Be sure to ask about this when you get cost estimates.

If your contractor does not handle these requirements for you, depending on where you live, you will need to check with your municipality or Frederick County Government about the permitting and inspection processes and fees. To learn about other considerations related to local codes and requirements, visit DOE's web page on *Planning for Home Renewable Energy Systems*[41].

After your PV system is installed, it will also need to be inspected by your utility before it can be activated. During 2012/2013, the time it took for Potomac Edison to schedule this inspection for Frederick County PV systems varied from less than two weeks to several weeks.

The actual installation of a solar PV system usually takes only a few days depending on the size of your system and whether or not any special modifications to your home or property are needed. From start to finish, however, the project may take several weeks to several months, depending on how busy your solar contractor is, and how long it takes Potomac Edison to inspect it. Be sure to ask your contractor about when they will be able to start the installation before you sign the contract.

PV systems will require routine, periodic maintenance and some components may need repair or replacement from time to time. Be sure to ask your solar contractor about warranties and maintenance options or services. If you are leasing your solar PV system, all maintenance and repairs will be taken care of by the company that owns the system.

There are a few more things to consider once your PV system is activated. Even though Potomac Edison must inspect the system before it is turned on, that does not necessarily mean that their billing department knows that you have a PV system. Because Potomac Edison frequently estimates monthly electricity usage, it is a good idea to call Customer Service and let the billing department know about your new system so they can adjust estimates accordingly.

If you are on a "budget plan" with your utility or energy provider that evens out your monthly payments over the year, you may want to consider getting off of it so you can see the impact of your PV system on your monthly bills. Otherwise, it can take a long while for your bills to reflect cost savings as you will be paying about the same amount each month.

Potomac Edison will now need two meter readings to calculate your monthly electricity usage; you will therefore see an extra set of meter readings on your bill. The Channel 4 reading on your new meter records the total kWh your household received from the electric grid since your PV system was installed. The Channel 40 reading records the excess kWh that your system produced but your household did not use; this excess is sent back to the grid. The difference between these two numbers is the amount of electricity you used from the grid since your last meter reading, and it is the amount you will be billed for.

If you have been in the habit of calling in your meter reading, or submitting it online, you will not be able to do so in the way you are accustomed. As of early 2013, you will need to call the Business Account phone number (866.523.4081) even though you are a residential customer.

Finally, once per year in the spring, if the total kWh your system has sent to the exceeds the total annual kWh your household has used from the grid, Potomac Edison will calculate your total banked kWh and credit your Potomac Edison account.

Chapter 5: Geothermal Heating and Cooling Systems

Contributors: David Barrow, Green Ambassador; John Boris, Jr., Maryland Department of the Environment

What They Are and How They Work

Geothermal heating and cooling systems use the heat of the earth to both heat and cool your home. In Maryland the ground temperature stays at a constant 55 °F year round, which provides a nearly optimal temperature for this equipment to efficiently heat and cool a home. During the summer months the heat taken out of the air in your house is transferred to the ground. The process works in reverse during the winter months, transferring the heat of the ground to the house.

Geothermal systems are heat pumps, but unlike a traditional heat pump, this system uses a combination of a multistage compressor[a] and a variable speed fan to provide a constant level of comfort to the home. The cost savings are immediately noticed because your heating and cooling processes start with air at 55 degrees as opposed to the ambient air temperature. Once the desired temperature is reached, the system will keep it at that temperature and you won't notice any air movement.

A geothermal system uses the fact that heat travels towards cold to transfer the earth's naturally occurring temperature to a working fluid (glycol). To perform this heat transfer, geothermal systems use piping buried in your yard, installed vertically in wells, or submerged in a nearby pond to allow this heat transfer to take place. For every ton of capacity[b], the system will need 150 feet of pipe. If your system is a 3 ton system, you would need 450 of pipe to operate it.

The illustration below demonstrates how the heat is transferred to and from the earth.

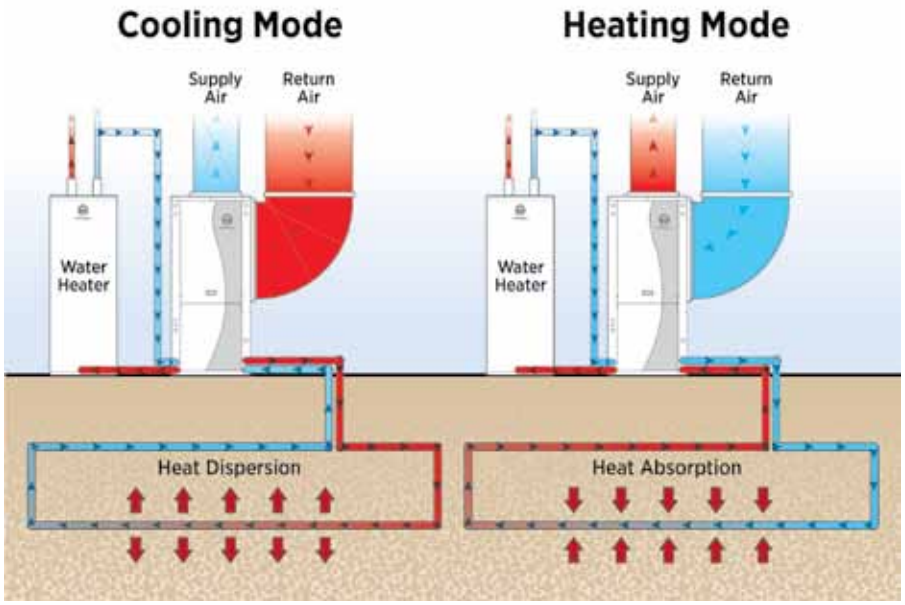
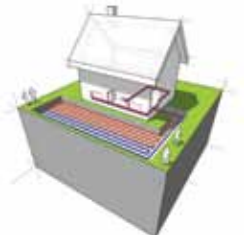
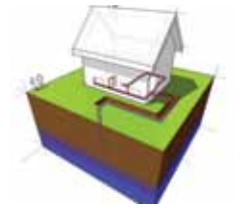


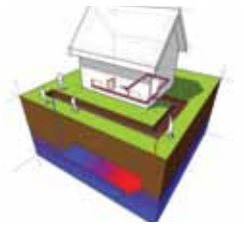
Image courtesy of Water Furnace®.

What makes a geothermal system so efficient is: 1) the earth's constant 55 °F temperature to do the thermal exchange, 2) it uses a liquid to do the thermal exchange instead of air, and 3) it rarely needs the electric resistant backup heat.

There are several types of geothermal systems allowable in Maryland; more details and diagrams of these are available at the U.S. Department of Energy's (DOE) web page on Geothermal Heat Pumps[42].







- **Horizontal closed-loop systems** may be most cost-effective for residential installations, especially for new construction where sufficient land is available. It requires trenches at least four feet deep.
- **Pond closed-loop systems** can be the lowest cost option. They take advantage of nearby bodies of water into which coiled supply lines are placed at least eight feet under the surface.
- **Vertical closed-loop systems** are better where there is little available land or where soil is too shallow for trenching. Holes, approximately four inches in diameter, are drilled about 20 feet apart and 100 to 400 feet deep. This type of system minimizes disturbance to existing landscaping.
- **Open-loop systems** use well or surface body water as the heat exchange fluid that circulates directly through the geothermal system. After water has circulated through the system, it returns to the ground through the well, a recharge well, or surface discharge. Because they are built like a normal residential water well, open loop systems garner further regulatory review. While they require additional permitting, the efficiency benefits outweigh the extra oversight.

The following chart shows a cost comparison to generate 100K[c] BTUs[d] of usable heat using different heat sources. (100K BTUs is about 80% of the energy in a gallon of gasoline, or in a little more than 8 pounds of coal.)

Cost Comparisons to Generate 100K BTUs of Usable Heat

Method	BTUs Generated	Per Unit	Usable	Units required to 100K	Unit price	Cost for 100K
Geothermal, 30 EER[e]	18,783	Kwh	100%	5.3241	$0.111	**$0.59**
Heat Pump, 16 SEER[f]	9,391	Kwh	100%	10.6482	$0.111	$1.19
Heat Pump, 13 SEER	7,630	Kwh	100%	13.1055	$0.111	$1.46
Wood Pellets	8,250	Pound	80%	15.1515	$0.116	$1.75
Natural Gas	100,000	Therm	80%	1.2500	$1.400	$1.75
Electric	3,415	Kwh	100%	29.2826	$0.111	$3.26
Propane	84,000	Gallon	96%	1.2401	$2.862	$3.55
Oil	95,000	Gallon	80%	1.3158	$3.650	$4.80

Chart provided by David Barrow.

Geothermal systems also can supply a limited amount of hot water. Excess heat from the compressor can be transferred to a hot water heater. During the winter heating season and summer cooling season, this can significantly reduce the amount of hot water you would need to create using traditional means.

Benefits

In addition to energy saving and utility bill reductions, geothermal systems have other benefits[43].

- **Quiet:** Geothermal heat pumps do not have outside condensing units like traditional heat pumps or air conditioners, so there's no concern about noise outside the home or the unit being vandalized. A two-speed system is so quiet inside that residents usually do not know it is operating
- **Small Space Requirements:** Hardware for geothermal systems requires less space than a conventional HVAC system, so the equipment rooms can be greatly scaled down, freeing space for productive uses.
- **Zone Conditioning:** Geothermal systems allow different parts of your home to be heated or cooled to different temperatures.
- **Reliability:** Geothermal systems have relatively few moving parts. All the equipment is self contained in the base of the air handler which is sheltered inside a building and is easily accessible for upkeep.

- **Durability:** Few moving parts, sheltered equipment, and underground piping, which often carry warranties of 25 to 50 years, mean that geothermal heat pumps are durable. Inside components last 25 years or more and the ground look may last 50 or more years.

Understanding the Incentives

The Information below on incentives is current as of January 2013. For the most up to date information on incentives, visit *www.DSIREUSA.org*.

1. State Grant: The state of Maryland currently (in 2013) offers a flat grant of $3,000 for the installation of a 1 ton[1] to 10 ton geothermal system for a residence[18].
2. Federal Investment Tax Credit: Under current law, geothermal systems installed on residences or businesses prior to December 31, 2016 are eligible for a 30% federal tax credit[19]. A homeowner who installs a $25,000 system could reduce their tax obligation by $7,500 for the tax year in which the system is installed. If the credit is larger than their tax bill in the year of installation, the remainder of the credit can be carried forward to future years.
3. Renewable Energy Credits (RECs): In 2012 the Maryland legislature passed a law that makes geothermal heat pumps an accepted technology available for Renewable Energy Credits. After the law goes into effect in 2013, homeowners with new geothermal systems will be eligible to receive Renewable Energy Credits (RECs). Check *www.DSIREUSA.org* for updates.

Pro-Formas*:	2 Ton	4 Ton	8 Ton	10 Ton
Installed Cost of System**	$19,000	$22,000	$27,000	$30,000
Maryland State Grant	$3,000	$3,000	$3,000	$3,000
Federal Tax Credit	$5,700	$6,600	$8,100	$9,000
Sale of Renewable Energy Credits (RECs)***	$100	$400	$800	$1,000
Electricity Savings in 1st Year****	$1,400	$2,800	$5,600	$7,000
Total Grants, Credits, and Savings in 1st Year:	$10,200	$12,800	$17,500	$20,000
Net Cost to System Owner at end of 1st Year:	$8,800	$9,200	$9,500	$10,000
Years 2-6 Electricity Savings and REC Revenues:	$7,500	$16,000	$32,000	$40,000
Net Cost to System Owner at end of Year 6	$1,300	-$6,800	-$22,500	-$30,000
Years to payoff investment	6.87	3.88	2.48	2.25

*For illustrative purposes only. A Pro-forma is assumed, forecasted, or informal information. It gives an idea of how the actual finances may look if underlying assumptions hold true. Actual costs and incentives depend upon site conditions and programs that are applicable to your situation. These pro-formas are not guaranteed and are subject to change without notice. Pro-forma provided by David Barrow.

**Cost estimated with the installation of horizontal ground loop. If you choose to install vertical ground loops, the cost for installation will be higher; however, you can include the additional cost in the total cost when requesting the federal tax credit.

***REC – Renewable Energy Credit estimated value of $100 per ton (awaiting Public Service Commission determination of value)

****Savings estimates compare a geothermal system to a heat pump with a propane backup.

Paying for a Geothermal System

A geothermal system is a major investment. In a typical home of 2,500 square feet, a geothermal system may cost $20,000 - $25,000 to install. While this is roughly double the cost of a conventional heating, cooling, and hot water system, geothermal heating/cooling systems can reduce utility bills by 40% to 60%. According to DOE's web page on *Choosing and Installing a Geothermal Heat Pump*[43], you may recoup your initial investment in two to ten years through lower utility bills depending on factors such as climate, soil conditions, the system features you choose, and available financing and incentives. When included in a mortgage, your investment in a geothermal system will produce a positive cash flow from the beginning. For example, if the extra $3,500 cost of the system will add $30 per month to your mortgage payment, the energy cost savings will easily exceed that added mortgage amount over the course of each year.

Grant and tax credit money will typically cover 40% of the total cost of the system, however in some cases it may take up to a year to get that money. Most installers will offer a 0% loan for up to 12 months on part or all of your cost; therefore, you can recover the grant and credit money. The remainder can then be paid out of pocket or be financed through a bank, credit union, home equity loan, or the Maryland Be SMART Home Complete loan program[35]. As of 2013, the Be SMART Home Complete loan program was offering up to $15,000 in unsecured loans at an interest rate of 4.99%. This program includes a home energy audit and does require using the program's approved contractors. They have a limited number of contractors for renewable energy systems; however, contractors can be added on a rolling basis. In addition, the FHA's *PowerSaver Program* allows eligible owners to borrow up to $25,000 at fixed rates to finance energy efficiency projects and renewable energy projects like geothermal systems. Enter "FHA PowerSaver Program" into your internet browser to learn more.

A few companies also offer financing plans that cover the upfront cost of installing a geothermal ground loop and more. Similar to solar system leases, "geothermal leases" enable a homeowner to install a geothermal ground loop without finding a contractor, paying the upfront installation cost, or contracting for subsequent maintenance or repair. Instead, these companies handle system installation, maintenance, and other associated costs. Property owners make monthly payments on multi-year financing plans. Enter "no money down geothermal" into your internet browser to find companies offering this type of financing plan for geothermal systems.

Deciding if Geothermal HVAC is Right for You

A geothermal system makes the most sense if you can answer yes to the following questions:

1. Do you own your house and expect to remain there for a minimum of 5 years?
2. you comfortable making a financial investment of over $20,000, or willing to apply for a loan or other financing?
3. Do you have enough land to support the piping necessary?
   a. For a horizontal installation, you will need a minimum of 1 acre of land.
   b. For a vertical installation, you will need a minimum of 1/4 acre as long as you have access to a location where large well drilling equipment can access it.
4. Can you continue to use your existing equipment for up to 45 days while you go through the permit process and installation of the equipment?

A negative answer question does not necessarily mean that a geothermal system is inappropriate for a property. It does suggest that it may be more difficult to maximize the value of the system or limit the financial benefits.

Installation: Requirements and Expectations

It is always a good idea to get assessments and estimates from more than one contractor. Refer to ***Appendix C: Contractor Selection Tips and Resources*** on page 47 to find and assess prospective installers. Based on the specific geological, hydrological, and spatial characteristics of your land, installers will determine the best type of ground loop for your site. It is strongly recommended that you consider an energy audit of your structure prior to installation. Just designing based on the current square footage without taking into consideration how "leaky" your structure is, may cause your system to become overloaded at temperature extremes or become less efficient over time.

The following steps will need to be performed to install a geothermal system. Every contractor is different; some apply for and pay for the permits on your behalf and roll costs into the contract, while others require you to apply for permits and call in inspections. Be sure to ask your contractor about this before your sign a contract.

1. Apply for a well permit for vertical installation or an excavation permit for horizontal installation (2 weeks).
2. Apply for electrical permit to install new circuits for equipment (2 weeks; can be done at same time as step 1 above).
3. Drill well(s) and/or dig trenches and install all the piping (1 to 2 weeks).
4. Remove existing equipment and install geothermal equipment and replacement duct hood (2 to 3 days).
5. Final electrical inspection (1 day).

The total time needed for installation from beginning to end is approximately 4½ weeks.

The only maintenance needed for the system is replacement of the furnace filter every 6 months. The homeowner can choose to buy a preventative maintenance package from the installer where they will change the filter and inspect the system, lubricate moving parts and visibly inspect other parts of the system.

Endnotes:

[a] A multistage compressor runs at two speeds, a slower speed when there is less demand on the system and at full speed when demand is high. This makes the system more efficient because the slower speed uses less energy. Most of the time the system will run in the slower speed.

[b] Ton - is a measure of capacity of and HVAC system. 1 ton equals 12,000 BTUs of heat.

[c] 100K - Shortcut for 100,000

[d] British Thermal Unit (BTU) is a measure of heat energy. Electric baseboard heat generates 3,415 BTUs per kilowatt of energy.

[e] EER - Energy Efficiency Ratio

[f] SEER - Seasonal Energy Efficiency Ratio

Chapter 6: Small Wind Turbines

Contributors: Laurie Wilmot, Intern; Dr. Carlos Fernandez-Bueno, Potomac Wind Energy

What It Is and How It Works – the Basics

Small wind turbines, or windmills, utilize moving air caused by differences in air pressure in our Earth's atmosphere to provide clean renewable energy[44, 45].

A wind turbine consists of the following key components:

- Blades connected to a central hub; together these are called the rotor.
- A shaft, a horizontal rod connected to the rotor which turns with the rotor.
- A gear box on the end of the shaft which turns with the shaft and connects to a generator.
- A generator that produces electricity.
- A tower or steel lattice that holds up the wind turbine.

More information on how wind turbines operate is available at the U.S. Department of Energy's *How Do Wind Turbines Work?* webpage[46].

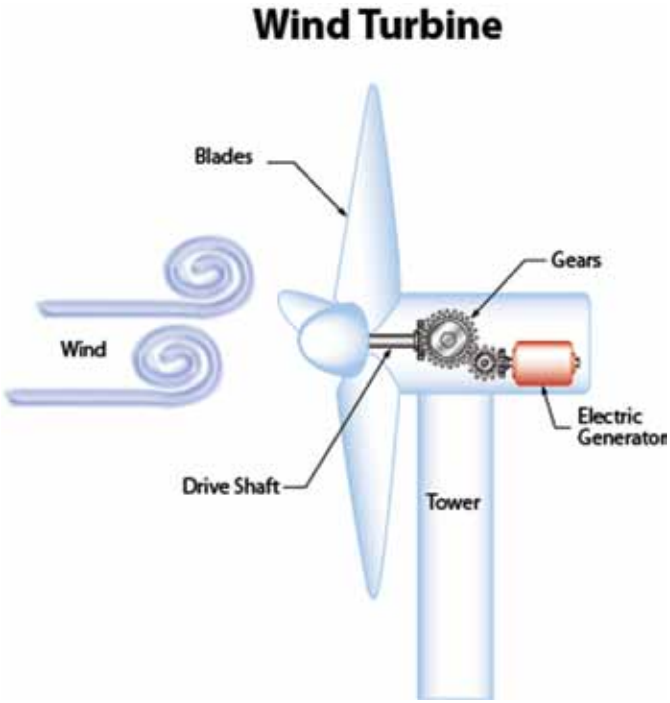


Illustration by Chip Gribben.

Costs of a Small Wind Turbine

Understanding the Incentives

The information below on incentives is current as of February 2013. There are no local incentives available at this time. For the most up to date information on incentives, visit *www.DSIREUSA.org*.

1. Incentives are available from the federal government for small wind turbines, including 30% of the project expense for projects up to 100 kW[47].
2. Incentives are also available from the State of Maryland for wind turbines via the Windswept Grant program[48], including up to 50% of net installation costs after federal and any local incentives. The maximum amount of grant money is $100,000.

Net metering: With grid-tied systems, wind energy customers can be compensated for energy they produce that goes to the grid under Maryland's net-metering law[49].

Pro Formas – Costs and Payback

The information below compares four wind turbine systems and shows the impact of incentives and tax credits as well as estimated net cash outlays.

Pro-formas*	5kW (60'tower)	6kW (47'tower)	10kW (80'tower)	20 kW (80'tower)
Estimated Output (12 mpg average)	950 kW/hr/mo	743 kW/hr/mo	1,900 kW/hr/mo	3,8 00 kW/hr/mo
Price (turnkey)	$80,000	$50,000	$95,000	$150,000
Federal Tax Credit	$24,000	$15,000	$28,500	$45,000
MD State Grant	$14,420	$14,420	$20,000	$20,000
Final Cost in MD	$41,580	$20,580	$46,500	$85,000
20 year estimated fixed cost per kW/hr	18.2 cents/kW/hr	11.5 cents/kW/hr	10.2 cents/kW/hr	9.3 cents/kW/hr

*For illustrative purposes only. A Pro-forma is assumed, forecasted, or informal information. It gives an idea of how the actual finances may look if underlying assumptions hold true. Actual costs and incentives depend upon site conditions and programs that are applicable to your situation. These pro-formas are not guaranteed and are subject to change without notice. Check *www.dsireusa.org* for the latest information on incentives. Pro-formas provided by Potomac Wind Energy[50].

The length of the payback period for a wind turbine is dependent upon the quality of the turbine, electricity rates, wind at the installation site, maintenance and insurance costs, financing options, and incentives. The time is takes to fully recover your costs can range from 2 to 20 years depending on these and other factors.

To get a rough idea of the payback period, determine the amount you pay on electricity bills each year before you plan to install your system. Take the cost of your turbine after incentives and add additional predictable costs such as insurance, maintenance, and financing costs. If your wind turbine will offset all your electricity, you can divide your estimate of the total cost by the annual bill and determine approximately how many years it will take to pay it off. If your wind turbine will only be offsetting part of your use, you will need to adjust the calculation accordingly.

Paying for a Wind Turbine

A wind turbine is a major investment. After incentives and tax credits are applied, costs may range from $20,000 to more than $80,000. Your return on investment (ROI) will depend on the size of turbine, height of the tower, average wind speed specific to your location and the current and projected price per kilowatt/hour charged by your utility.

Grant and tax credit money may cover 40-60% of the total cost of a system, however in some cases it may take up to a year to get that money.

Third party loan programs are available through some turbine manufacturers. Home equity and lines of credit are available from your lending institution.

Deciding if the System is Right for You

Proper siting of a small wind turbine is the most important factor. Households seriously considering installing a small wind turbine should consult Southwest Windpower's excellent and concise *Consumer Guide: Wind Turbine Siting*[51].

Before deciding if a small wind turbine is the right system for you, consider the following questions:

1. ***What are the recommended criteria for a wind turbine?***

   They include: (1) a clear, smooth, and exposed location, (2) good western wind exposure, (3) an accessible site, and (4) ability to tie into electric grid (battery storage is an option).

2. *What is the average wind speed for your specific site? This is the most important factor!*

   The US Department of Energy (DOE) recommends wind speeds from 9.8 up to 15 miles per hour are required for a small wind turbine and to acquire a sufficient amount of electricity to make the investment cost-effective[52]. More information is available at DOE's National Renewable Energy Laboratories' *Wind Resource Assessment* web page[53]. The State of Maryland's Anemometer Loan Program loans wind measuring devices to property owners allowing them to quantify wind resources on their property[54].

3. ***Will installing a wind turbine comply with Frederick County's zoning ordinance or other local restrictions or ordinances?***

   One important criterion is that wind turbines should be sited on a minimum of one acre of land. Be sure to check Frederick County's windmill ordinance[55] to make sure the windmill dimensions fulfill the requirements. If you are in a municipality, be sure to check their ordinances as well. For more information, refer to the "Local Issues, Restrictions, and Ordinances section" below.

4. ***Will your neighbors be concerned about your wind turbine installation?***

   If you live in a neighborhood, it would be advisable to consult your neighbors regarding your interest in building a wind turbine first. It will minimize opposition if they understand how it will impact them[52]. Urban or densely developed neighborhoods are not suitable for small wind turbines. Better renewable energy options for urban environments may be solar PV or thermal systems.

5. ***How much electricity can be produced?***

   This varies depending on the wind speed and system size. The U.S. Department of Energy's *Small Wind Electric Systems: A U.S. Consumer's Guide*[52] estimates that a 1.5 kilowatt system (costing about $7,000) can produce 300 kilowatt hours of electricity a month with a 14 mph wind speed on average. The power of wind is exponential so the same 1.5 kilowatt system will only produce about 37 kW/hr per month at a 7 mph average wind speed.

6. ***Will the amount of electricity produced be worth the investment needed to install and maintain a wind turbine?***

   Examining installation and maintenance costs should be part of the decision making process. Another expense to factor in is the cost of the base for the wind turbine.

7. ***What about roof-mounted micro-wind turbines?***

   These turbines are intended for dense urban areas. There are several things to consider before making the financial commitment. The cost to purchase and install micro-wind turbines may be excessive compared to the amount of electricity generated. They may produce noticeable noise in the house. In addition, most roofs may not be structurally sound enough to support a wind turbine that can generate a lot of vibration.

A small wind turbine makes the most sense if you can answer yes to the following questions:

1. Do you live on one or more acres of land?
2. Do you plan to keep this property for 10 or more years?
3. Are you comfortable making a financial investment of over $20,000, or willing to apply for a loan or other financing?
4. Do you have consistent wind speeds from 9.8 up to 15 miles per hour on your property?
5. Can the wind turbine be easily connected to electric meters and the grid?

Local Installation: Requirements and Expectations

It is always a good idea to get assessments and estimates from more than one contractor. Refer to *Appendix C: Contractor Selection Tips and Resources* on page 47 to find and assess prospective installers.

Frederick County has a wind ordinance (Ordinance Number 09-11-515)[55]. The ordinance has a size and height restriction for residential wind turbines. A few key points in the wind ordinance follow; read the full ordinance for more details.

Assorted small wind turbines at Potomac Wind Energy in Dickerson, MD

- The ordinance applies to wind turbines with a height of 10 ft. or more.
- Power produced must be used to run the property; owners cannot sell electricity produced.
- The structure must be a certain distance away from the following (as determined by the height of the tower + the length of the blade + 20 ft.):
  - County right of way (as referenced on the comprehensive plan),
  - Entrance or exit from the property,
  - Above ground power lines, and
  - All property boundaries.
- Tip of the lower blade needs to be at least 30 ft. above obstruction.
- The structure cannot be placed in the required front yard setback.
- Putting lights on the wind turbine is not allowed unless required by the Federal Aviation Administration (FAA).
- The blade tip or vane of the wind turbine must have a clearance of no less than 15 ft. with the reference point being the lowest point of the blade arcs.
- There can be no more than two wind turbines per property.

Typical small wind turbines are purchased as a "Turn Key" Installation. The dealer/ installer secures the appropriate permits, inspections, and subcontractors and assist the customer in filling applications for Maryland Energy Administration 'Wind Swept 'Grant and for Net Metering from the utility power company.

Renewable Star Certification Form

Use this form to check off each Renewable Star Step and to enter your total Green Points earned for completing Renewable Energy Actions. Alternatively, certify online at *www.FrederickGreenChallenge.org*.

You can earn Green Points for actions completed either before or during the Green Homes Challenge. If you complete the steps and your Total Points add up to at least 10, they you are ready to submit your Renewable Star Certification Form! Information from your Certification Form will be used to track energy savings and greenhouse gas emissions reductions achieved through the Green Homes Challenge.

Household Name (as you would like it to appear on recognition materials): _____

Contact Person: _____ Daytime Phone: _____ Email Address:_____

Renewable Star Steps:

1. Register (and take the optional Pre-Survey). . . . . ✓
2. Implement Renewable Energy Actions to earn 10 points. . . . . ✓
3. Submit Renewable Star Certification From (this form).. . . . . ✓

Renewable Energy Actions:

1. Purchase clean renewable energy through your utility.
    a. Purchase 100% of your home's electricity from renewable energy sources. 20
    b. Purchase 50% of your home's electricity from renewable energy sources. 10
2. Purchase Renewable Energy Certificates (RECs) to offset your household's greenhouse gas emissions
    a. Purchase RECs to offset 100% of your home's electricity use. 20
    b. Purchase RECs to offset 50% of your home's electricity use. 10
3. Use a solar oven or cooker. 1
4. Use bio-heating oil in your furnace. 2
5. Use efficient furnaces and stoves designed for biomass fuels.
    a. Replace an older inefficient wood burning stove with a new efficient wood or pellet stove. 3
    b. Purchase a new efficient biomass stove or furnace. 2
6. Use biofuel in your flexible fuel or diesel vehicle. 2
7. Install a solar water heating system 10
8. Install solar photovoltaic (PV) panels. 20
9. Install a geothermal heating and cooling system. 15

Continued

10. Install a small wind turbine on your property. 20

11. Refer 5 Frederick County households to the Green Homes Challenge. 1

12. Attend a workshop, seminar, webinar, or discussion about renewable energy. 2

13. Become a Green Ambassador. 4

TOTAL EARNED /100*

Earn Bonus Points

(See page 16 in Renewable Energy Actions Catalog for details)

Actions (specify):

1._____

2._____

3._____

TOTAL EARNED

Total Points for Renewable Star Certification: TOTAL EARNED /100*

*Total of 100 assumes that the maximum points likely earned from Actions 1 and 2 is 20.

MAIL, FAX OR EMAIL TO:
Green Homes Challenge Coordinator, 30 North Market Street, Frederick, MD 21701
Fax: 301.600.2054 • Email: GreenHomes@FrederickCountyMD.gov

Meet Some Frederick County Renewable Stars

David and Jan Barrow's 16.9 kW solar PV System

Long before Myersville residents David and Jan Barrow installed renewable energy systems, they focused on being efficient with their use of energy. When they built their house in 1995, they positioned it due south to take advantage of passive solar heating. This was their first step in using renewable energy. They also built their house with a larger than normal overhang to prevent the summer sun from entering the house.

When they upgraded their deck to an enclosed sunroom, they chose to use an energy efficient pellet stove to provide heat to the new room. This was their second step in using renewable energy.

In May of 2009, the Barrows decided to take advantage of the incentives available to make their house more energy efficient before they retired. The Barrows started with a geothermal heating, air conditioning, and water heating system. They also corrected problems with air infiltration discovered during a home performance energy audit. David, being an analyst, decided to use all the statistics he had kept on their energy consumption to justify the expenditure and to validate the results of upgrades they performed. As a result of the upgrades, the Barrows have reduced their consumption of electricity by 35%, propane by 83%, and wood pellets by 69%.

This kind of energy efficiency savings justified going even greener with a renewable energy solar photovoltaic (PV) system that generates 99% of the electricity they use. Today, they purchase only 1% of their electricity from wind farms through their utility, and their total annual utility bill averages just $93.

Here's how the Barrows did it:

- **They installed a wood pellet stove in their sunroom.**

  The Barrows choose a wood pellet stove because
  - The energy source was renewable;
  - The temperature controls and automatic starter and shutoff keeps the room at a pre-set temperature without intervention; and
  - Highly efficient burn process results in a minimal amount of smoke and the ash generated by one ton of pellets can fit in a one cubic foot container.

- **They used a certified contractor to conduct a Home Performance Energy Audit**

  This essential analysis identified significant issues in their home that needed attention. For example, it
  - Determined that air infiltration was more than double the amount it should have been for a house their size;
  - Found that the temperature differential in their skylights was 30 degrees between the bottom and top of the skylight well; and
  - Justified adding more insulation even though the current amount was above the old code level;

David filling the pellet stove in their enclosed sunroom.

David points out that the pump for the geothermal HVAC system does not need to be very large or powerful.

David demonstrates how their geothermal HVAC system preheats water for their hot water heater.

- **They reduced air infiltration and increased insulation (net savings 8%)**
  - A spray foam contractor sealed the skylight wells, bathroom fans, recessed light fixtures, exposed duct work, and the ceiling of a crawl space.
  - They upgraded attic insulation from R38 to R57.
  - They insulated their attic access panel.

- **They installed a Geothermal Heating and Air Conditioning System (HVAC) (net saving 42% - electricity, propane, and pellets)**
  - A new 4 ton geothermal system replaced the old hybrid propane heat pump system.
  - They also installed a geothermal hot water heater. Whenever the geothermal HVAC system runs during the winter or summer, water is preheated before it reaches their super-efficient propane hot water heater.

- **They installed a 16.9 kW Solar PV System (net savings 40%)**
  - They measured their electricity consumption for one year after the initial efficiency improvements were made.
  - Then they purchased a roof-mounted solar PV system that would produce 75% of their annual usage knowing that they would continue to make energy improvements when other equipment in their house failed.

- **They purchase the remainder of the electricity they need from Wind Farms.**
  - For the 1% of electricity the Barrows still use from the grid, they ensured that it comes from clean renewable wind farms by selecting Washington Gas Energy Services CleanSteps as their energy supplier.

Appendix C: Contractor Selection Tips and Resources

Specialized technical knowledge and equipment are needed to properly install renewable energy systems. In addition, you may need information for, or assistance with, required permits and inspections, incentive programs and rebates, and tax credits. Therefore it is a good idea to take time to ensure that you select an experienced, licensed, and helpful contractor. Here are some tips and Resources for doing so:

Finding a Contractor

- *Leafkey.com** is one online resource to find renewable energy system installers with verified credentials. OSER partnered with Leafkey.com in 2012 and 2013 to populate this database with contractors and eco-professionals serving Frederick County. You can search for a variety of green contractors or eco-experts within a certain radius of your zip code. You will find company descriptions, contact information, and credential and licensing information and verification.

- You can also find contractors through the phone book, professional associations, and internet searches. Entering search strings, such as "find geothermal installers", into your internet browser can direct you to directors of installers.

- It is always a good idea to request site assessments and get estimates from more than one contractor.

Choosing a Contractor[27, 56, 57]

As a consumer, do your due diligence to screen potential installers and find a suitably experienced contractor. Here are some questions and requests prospective installers should be prepared to handle:

Experience and Credentials:

- Is your company licensed or certified?

  Having a valid plumber's, electrician's, and home improvement licenses are required for permits. Confirm licensing with Leafkey.com or the Maryland Department of Labor, Licensing and Regulation[58], where you can also find out about any complaints against state-licensed contractors.

- How many years of experience does your company have with system installation and maintenance?

  The more experience the better. Choose a company that has experience installing the type of system you want and servicing the applications you select.

- How many similar systems have you installed?

- Can you provide references from past customers with similar systems?

- Does the company have any pending or active judgments or liens against it?

  In addition to the Department of Labor, Licensing and Regulation, the Better Business Bureau is another source of information.

Permits, Installation, Inspections, and Incentives:

- Do you handle acquisition of permits and scheduling of inspections? Do you have experience working with building code officials in Frederick County or, if applicable, utility representatives?

- How long will system planning and design take?

- When can installation start, and once started, how long will the project take?

- Will you hire subcontractors to work on portions of the projects? If so, what firms will be hired and what will they do?

Equipment, Operations, Maintenance, and Warranties:

- How long will the system last? Can you describe the different components of the system and which components will need to be replaced and when?
- What kind of training will you provide me with so that I can better operate and maintain my system?
- What warranties come with the system?
- What kind of maintenance or service agreements do you offer?

Payment, Financing, and Incentives

- Using my utility bill data, can you show me how much of my household's energy use will be offset by the system?
- With the energy cost savings from the renewable energy system, how long will it take to recoup the investment?
- Do you offer system leasing, power purchase agreements, or a third-party ownership option?
- Does your company offer any financing plans or loans?
- Are you familiar with federal, state, local and power company tax benefits or rebates? Do you have experience assisting customers apply for incentives and rebates?
- Will you or a partner company be able to assist me in selling the Renewable Energy Certificates generated by my system?

*Disclaimer: The Frederick County Office of Sustainability and Environmental Resources (OSER) has not investigated, and expressly disclaims any duty to investigate, any company, product, service, process, procedure , design, or the like, which may be presented on the aforementioned websites. The presentation of these website links does not constitute endorsement, warranty, or guaranty, by OSER of any company, product, service, process, procedure, design, or the like. The entire risk of any information presented is assumed by the user.

Glossary of Renewable Energy Terms

This glossary includes terms that are found in this handbook and are related to the Renewable Star Challenge. Content was taken, in part, from the U.S. Environmental Protection Agency's Clean Energy Glossary[59], the Center for the Advancement of Process Technology[60], the U.S. Department of Energy Tribal Energy Program glossary[61], and the Mother Earth News Renewable Energy Glossary[62].

Alternating Current (AC): Electric current that reverses direction 50 or 60 times per second (depending on the country). AC is used to transport large amounts of electricity over long distances. Transformers downgrade AC to a standard 120 volts for household use. Standards vary by country.

Alternative Fuel: Any fuel determined to be substantially not petroleum and yielding potential energy security benefits and substantial environmental benefits. Includes fuels such as biodiesel, hydrogen, methanol, liquefied natural gas, and electricity.

Ampere (Amp): A measure of the quantity of electricity flowing in a circuit. Amps measure electric current, which is a count of the number of electrons flowing through a circuit. One amp is the amount of current produced by a force of one volt acting through the resistance of one ohm, a measure of the resistance of different materials.

Amp-hour: Measure of the amount of electrical current flowing for a period of time.

Annual Consumption: Annual consumption refers to the amount of electricity used by a consumer in one year and is typically measured in kilowatt-hours (kWh). This information can be acquired from your electricity bill or by contacting your energy provider.

Backup Electricity (Backup Services): Power or services needed occasionally, for example, when on-site generation equipment fails**.**

Biodiesel: An alternative fuel produced from renewable resources such as plant oils, animal fats, used cooking oil, and new sources such as algae. Biodiesel contains no petroleum, but can be combined in any quantity with petroleum diesel to create a biodiesel blend. Biodiesel blends can be used in most "compression-ignition" (diesel) engines with little or no modifications. Biodiesel is simple to use, biodegradable, nontoxic, and essentially free of sulfur and aromatics (the "diesel" odor).

Bioenergy (Biomass Energy): The conversion of the complex carbohydrates in organic matter to energy. Organic matter may either be used directly as a fuel or processed into liquids or gases.

Biogas: A combustible gas derived from decomposing biological waste. Biogas normally consists of 50 -60% methane.

Biomass: Refers to biological materials, such as trees andtplants, which were alive or created during our lifetimes. It can also mean waste products like trash. When burned, biomass materials release heat. Examples of biomass include grass clippings, wood chips, animal manure, and non-toxic trash. Biomass exists in landfills, where bacteria break down the waste material, creating methane gas in the process, which can be captured and burned. Energy from biomass is most often captured to generate electricity.

British Thermal Unit (BTU): A unit of heat energy equal to the heat needed to raise the temperature of one pound of water one degree Fahrenheit at one atmosphere pressure (sea level).

Closed-Loop Drainback Solar Thermal System: A non-pressurized closed-loop system that uses water as a heat transfer fluid (or a minor glycol mix in freezing areas). A small drainback reservoir is added to the collector loop so during the evening, or when cutoff temperatures are reached, the system's pump is turned off, the fluid in the collectors drains into the reservoir, and the collectors remain dry. This provides gravity based freeze protection in the winter.

Closed-Loop (Indirect) Geothermal Heat Pump System: A geothermal heating system that circulates a solution of water and antifreeze through a series of sealed loops of piping. Once the heat has been transferred into or out of the solution to heat or cool your home, the solution is recirculated. The loops can be installed in the ground horizontally or vertically, or they can be placed in a body of water, such as a pond. Also known as an "indirect" system.

Coal: A combustible rock formed from plant and animal matter that has been subjected to geologic heat and pressure, transformed over millions of years into hard black solids. Because coal is a readily available resource in the United States, coal power plants provide about half of the nation's electricity. However, coal-fired power plants generally cause more pollution per unit of electricity than any other fuel. Most coal plants are required to have several pollution control devices to reduce the amount of pollutants that are released into the air from burning the coal. These controls have played an important role in cleaning up air quality in many areas of the country.

Direct Current (DC): An electric current that flows in a constant direction. The magnitude of the current does not vary, or has a slight variation. Battery operated devices use DC. Solar photovoltaic systems produce DC; inverters convert the DC output into utility frequency alternating current (AC) allowing the powering of ordinary commercial appliances.

Electricity Supplier: A company that buys and sells electricity, including green power from renewable energy sources.

Emissions: Human caused releases of gases to the atmosphere. In the context of global climate change, they consist of important greenhouse gases such as carbon dioxide, methane, and nitrous oxide.

Energy crops: Crops grown specifically for their fuel value, such as corn, sugarcane, and switchgrass.

Energy Efficiency: Refers to products or systems using less energy to do the same or better job than conventional products or systems. Energy efficiency saves energy, saves money on utility bills, and helps protect the environment by reducing the amount of electricity that needs to be generated.

Evacuated Tube: Refers to a type of a solar thermal collector, in which the "tube" is essentially two glass tubes that are fused at the top and bottom. The inner tube has a solar absorbing coating, and the space between the two tubes is evacuated to form a vacuum, which is an excellent insulator.

Flat Plate Collector: A solar thermal collector that typically consists of a metal frame, glazing, absorbers (usually metal), and insulation and that uses a pumped liquid as the heat transfer medium. Its predominant use is in water heating applications.

Fossil Fuels: Fuel formed in the geological past from the remains of living organisms, primarily, coal, oil, and natural gas. Fossil fuels are the nation's principal source of electricity. Because fossil fuels are a finite resource and cannot be replenished once they are extracted and burned, they are not considered renewable.

Geothermal Energy: Heat from the earth, often thought of as energy from geysers and hot springs. More recently, this term is applied to any heat stored in earth and available as a renewable energy resource. As used at electric power plants, hot water or steam extracted from geothermal reservoirs in the Earth's crust is supplied to steam turbines that drive generators to produce electricity.

Geothermal Heat Pump: A heat pump in which the refrigerant exchanges heat (in a heat exchanger) with a fluid circulating through an earth connection medium (ground or ground water). The fluid is contained in a variety of loop (pipe) configurations depending on the temperature of the ground and the ground area available. Loops may be installed horizontally or vertically in the ground or submersed in a body of water.

Green Power: Electricity generated from renewable energy sources. Green power products can include electricity generated exclusively from renewable resources or, more frequently, electricity produced from a combination of fossil and renewable resources. Also known as "blended" products, these products typically have lower prices than 100 percent renewable products. Customers who take advantage of these options usually pay a premium for having some or all of their electricity produced from renewable resources.

Green Power Marketers: Energy providers that operate in states that permit retail competition in the electricity markets, and offer green power products. In states that do not allow this retail competition, many utilities have begun offering green power options under what are typically referred to as green pricing programs.

Greenhouse Gases: Gases in the Earth's atmosphere that produce the "greenhouse effect," a process through which gases in the earth's atmosphere let in light but trap heat. Changes in the concentration of certain greenhouse gases, due to human activity such as fossil fuel burning, increase the risk of global climate change. Greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide, ozone, and various forms of fluorocarbon gas (used in air conditioners and refrigerators).

Grid: The network of wires and cables that transport electricity from a power plant to your home.

Heat Pump: A year-round heating and air-conditioning system employing a refrigeration cycle. In a refrigeration cycle, a refrigerant is compressed (as a liquid) and expanded (as a vapor) to absorb and reject heat. In the heating mode, the refrigerant within the heat pump absorbs the heat to be supplied to the interior space from an outside medium (air, ground, or ground water). In the cooling mode, the refrigerant absorbs heat from the interior space and rejects it to the outside medium. An air-source heat pump is the most common type.

Inverter (Solar Inverter, PV Inverter): An electrical device that changes direct current (DC) into alternating current (AC). For solar photovoltaic systems, the inverter converts the variable direct current (DC) output of a photovoltaic (PV) solar panel into a utility frequency alternating current (AC) that can be fed into a commercial electrical grid or used by a local, off-grid electrical network. It is a critical component in a photovoltaic system, allowing the use of ordinary commercial appliances.

Kilowatt (kW): One thousand watts of electricity (see "Watt").

Kilowatt-hour (kWh): One thousand watt-hours. Calculated by multiplying the number of watts being used times the length of time in hours that amount of electricity is used. A refrigerator that uses 250 watts will consume one kilowatt-hour of energy in four hours (250 watts x 4 hours = 1,000 watt-hours or one kilowatt-hour). Utility bills are based on the number of kilowatt-hours consumed each month.

Line losses: Electrical energy lost due to inherent inefficiencies (electrical resistance) in an electrical transmission and distribution system under specific conditions.

Megawatt (MW): From"mega",, meaning million, and "watt", a unit of energy (see "Watt"). A megawatt is one million watts of electrical energy. One megawatt is equivalent to the energy consumed by ten thousand 100 watt light bulbs illuminated at the same time.

Methane (CH_4): A colorless, odorless and tasteless gas produced over time in environments with little or no oxygen by bacteria that feast on decomposing organic matter. Methane is a primary component of natural gas, and therefore an important fuel source that produces fewer greenhouse gases when it is burned than coal or oil. Methane that is released and not burned, however, is reportedly 20-25 times more effective at trapping in heat than carbon dioxide, making it one of the most potent greenhouse gases. Methane accounts for 16 percent of the greenhouse gas emissions produced by human activities such as natural gas production, agriculture, landfills, coal mining, and manure-management systems. Of significant scientific concern are the vast amounts of methane trapped in frozen tundra and permafrost. As the arctic region warms and tundra thaws, methane will be released in huge quantities, amplifying feedback in the entire carbon cycle (i.e., more melting producing more methane, which warms the climate, causing more melting).

Net Metering: An electricity policy for consumers who own (generally small) renewable energy facilities (such as solar PV systems or small wind turbines). The contractual arrangement permits an electrical utility customer to sell any excess power generated (over and above their usage requirement) back to the electrical grid to offset some or all of their consumption. "Net", in this context, means the utility electricity usage that remains after subtracting the electricity put onto the grid by the consumer's renewable energy system. Depending on individual state or utility rules, the net excess generation may be credited to their account (in many cases at the retail price), carried over to a future billing period, or ignored.

Natural Gas: Underground deposits of gases consisting of 50 to 90 percent methane and small amounts of heavier gaseous hydrocarbon compounds such as propane and butane.

Nuclear Energy: Energy originating from the splitting of uranium atoms in a process called fission. At the power plant, the fission process is used to generate heat for producing steam, which is used by a turbine to generate electricity. Because nuclear power plants do not burn fuel, they do not emit air pollutant emissions; however, nuclear power plants in the United States collectively produce about 2,000 metric tons per year of high level radioactive waste. Such waste can remain active and, if not properly stored, be detrimental to the environment and human health for hundreds of thousands of years. There are more than 60 nuclear power plants currently in operation in the U.S. that produce approximately 20 percent of the country's electricity production. No nuclear power plants have been built since 1996, mostly due to economic factors and environmental concerns.

Off-the-grid (Off-grid): Not connected to the commercial power lines.

Oil: A liquid fossil fuel formed from layers of buried plants and animals that have been subjected to geologic heat and pressure over a long period of time. The energy that the plants and animals originally obtained from the sun is stored in the oil in the form of carbon. In addition to carbon, oil contains elements such as nitrogen, sulfur, mercury, lead, and arsenic. Oil is a nonrenewable resource because it cannot be replenished in a human time frame.

Open-Loop Geothermal System (Direct Geothermal System): A geothermal heating and cooling systems that circulates water drawn from a ground or surface water source. Once the heat has been transferred into or out of the water, the water is returned to a well or surface discharge (instead of being recirculated through the system). This option is practical where there is an adequate supply of relatively clean water, and all local codes and regulations regarding groundwater discharge are met.

Open-Loop (Direct) Solar Thermal System: A solar thermal system that pumps household water through solar collectors, where it is directly heated by the sun. The heated water then circulates back into the home to be used for bathing, laundry, etc. This design is also known as "open-loop" and it works well in climates where freezing temperatures are rare.

Passive Solar: A system in which solar energy alone is used for the transfer of thermal energy. Pumps, blowers, or other heat transfer devices that use energy other than solar are not used.

Photovoltaic (PV): Light-generated voltage, or producing electricity from light. "Photo" means light and "voltaic" means voltage.

Photovoltaic (PV) Cell (Solar Cell): An electronic device consisting of layers of special materials capable of converting light directly into electricity.

Photovoltaic (PV) Module (Solar Module, Solar Panel): An assembly of interconnected photovoltaic cells enclosed in a protective assembly (usually glass and plastic). These are the large collections of solar cells that can produce electricity in a worthwhile quantity.

Renewable Energy Certificate (REC), (Renewable Energy Credit, Green Tag): A certificate that quantifies the amount of clean energy a generator has produced from a clean, renewable source (such as wind or solar) and transmitted to the power grid. The generator accounts for the clean energy transmitted by assigning a unique "certificate," Green Tag, or number to each megawatt-hour (MWh) of electricity generated. The generator uses the certificates to account for how much clean energy was produced and how much clean electricity utilities and consumers can buy. A REC is sold separately from the electric power the system generates. Most RECs are certified by a third-party entity and sold as a commodity to offset the pollution from electricity generated by burning fossil fuels. Whoever owns or purchases a REC can claim ownership of the environmental benefits attributable to clean renewable energy projects.

Renewable Energy: Generally refers to electricity supplied from renewable energy sources or generated without use of fossil fuels. Energy sources, such as wind and solar power, geothermal, hydropower, and various forms of biomass are considered renewable because they are continuously replenished on the Earth.

Renewable Portfolio Standard (RPS): A mandate requiring that renewable energy provides a certain percentage of total energy generation or consumption. Maryland's Renewable Portfolio Standard (RPS) requires that 20 percent of Maryland's Electricity be generated from renewable energy sources by 2022, including 2 percent from solar energy.

Silicon: A semiconductor material made from silica, purified for photovoltaic applications.

Solar Cell: See Photovoltaic (PV) Cell.

Solar Energy: The radiant energy of the sun, which can be converted into other forms of energy such as heat or electricity.

Solar Module (Solar Panel): See Photovoltaic (PV) Module (Solar Module, Solar Panel)

Solar Renewable Energy Certificate (SREC, Solar Renewable Energy Credit, Green Tag): A tradable certificate that represents the clean energy benefits of electricity generated from a solar electric (PV) system (see Renewable Energy Certificate). One SREC is issued for each megawatt (MW) of electricity generated. An SREC is sold separately from the electric power the system generates.

Solar Thermal: The process of deriving or concentrating heat from sunlight. Examples of "derived heat" are: home heating, solar cooking, clothes drying, and solar heated water. Concentrated solar thermal heat is often used to create steam, from which electric power is generated.

Sustainable: Pertains to the economic, social, and environmental systems that make up a community as a whole, and whether all three are working in concert to provide a healthy, productive, meaningful life for all community residents, present and future.

Thermal Solar: See Solar Thermal.

Thin Film (Thin Film Solar Cell, TFSC): Refers to one of the solar electricity technologies in which one or more thin layers (thin film) of photovoltaic material is deposited onto various surfaces such as glass, plastics, or metals. This requires 98-99% less material, and less time to manufacture, resulting in cost savings. Thin film, however, is not as efficient as conventional solar modules and therefore requires more space.

Transformer: An electrical device for changing the voltage of alternating current.

Turbine: A machine for generating rotary mechanical power from the energy of a stream of fluid (such as water, steam, hot gas, or wind). Turbines convert the kinetic energy of fluids to mechanical energy.

Utility: A municipal or private business that provides electricity to the public and is subject to governmental regulation.

Volt: A unit of electrical pressure; quantifies the size of the force that sends electrons through a circuit.

Watt: A unit of electrical power. Watts are calculated by multiplying the electrical pressure in a circuit (volts) by the amount of electricity moving in the circuit (amps). For example, 120 volts times 2 amps equals 240 watts.

Watt-hour (Wh): A unit of energy equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour. For instance, a 60 watt incandescent light will consume 600 watt-hours of energy when used for ten hours (60 watts x 10 hours = 600 watt-hours). Electric bills are based on the number of watt-hours, or kilowatt hours (kWh) of energy co**Wind Energy:** The kinetic energy of air in motion that can be converted to mechanical energy for driving pumps, mills, and electric power generators.

Wind Power: The conversion of wind energy into a useful form of energy; for example, using wind turbines to make electrical power, or windmills for mechanical power, or sails to propel boats.

Wind Power Plant (Wind Farm): A group of wind turbines interconnected to a common utility system through a system of transformers, distribution lines, and (usually) one substation.

Wood Pellets: Sawdust compressed into uniform diameter pellets to be burned in a heating stove.

Wind Turbine (Wind Generator): Devices consisting of blades that turn a shaft that turns a generator to harvest wind energy and produce electrical power. (Often mistakenly call a “windmill,” which is a building with sails or vanes that turn in the wind and generate rotational energy for grinding grain into flour, pumping water, or other industrial uses.)

Appendix E: References

Any views or opinions presented in these resources are solely those of the authors and do not necessarily represent those of the Frederick County Government or Green Homes Challenge program funders.
All online links were active as of March 1, 2013.

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GREEN HOMES CHALLENGE
FREDERICK COUNTY, MD

Are you motivated to inspire others to take action for a greener home, community, or planet? Are you part of an affiliated group through work, worship, school, or community activities?

Be a Green Ambassador!

What is a Green Ambassador?

A Green Ambassador serves as a volunteer leader for one year and commits to motivating others to become more energy efficient, adopt environmentally-friendly lifestyles, and use renewable energy. It's a flexible role; there is no set schedule or required number of volunteer hours. You can serve individually or pair up with another Green Ambassador in the community you wish to serve. Green Ambassadors may use the Green Homes Challenge tools and resources and implement their own creative ideas and strategies! You can serve as a Green Ambassador almost anywhere… in your workplace, school, place of worship, homeowner's or neighborhood association, civic or recreational organization, mom's or singles club, or youth or scouting group.

Our goal *is to engage 2,000 households in the Green Homes Challenge by 2014! Can you help us get there?*

What types of things can Green Ambassadors do?

Green Ambassadors choose at least one of these primary roles:

- Host at least two Powerware Parties, or other informational workshops related to the Green Homes Challenge.
- Navigate people through the Green Homes Challenge certification process,
- Lead or organize a "Green Team" that meets regularly to support group progress, or
- Provide outreach assistance for the Challenge by helping to staff booths at community events or presenting to community or school groups.

If you decide to get more involved, you can also:

- Implement a Green Homes Challenge registration drive,
- Set up an online social networking group to keep people motivated and informed about group progress,
- Organize discussion groups, demonstration workshops, or potluck meals, or
- Distribute information and resources door-to-door.

What qualities make a good Green Ambassador?

Successful Green Ambassadors are:
- Known and respected in their affiliated community,
- Outgoing, friendly, engaging and responsive,
- Organized and proactive,
- Easily accessible through person-to-person visits, email, phone, or social networking tools,
- Passionate about promoting energy conservation and sustainability, and
- Motivated to "walk the talk" and lead by example!

What Responsibilities would I have as a Green Ambassador?

Requirements are minimal but include:
- Filling out the Green Ambassador Registration and Commitment Form,
- Submitting a simple Monthly Green Ambassador Update documenting the types of things you have done in your community, how many people have been engaged, and hours spent volunteering,
- Filling out occasional online surveys about your experience as a Green Ambassador,
- Maintaining communication with the Green Homes Challenge staff, and
- Registering with the Green Homes Challenge and working towards Power Saver, Green Leader, and/or Renewable Star Certification.

How will Green Ambassadors be Supported?

Green Ambassadors will receive:
- One-on-one orientation and training by Office of Sustainability and Environmental Resources (OSER) staff,
- On-going one-on-one consultation and support through periodic phone calls and email messages from OSER staff,
- Opportunities to network with other Green Ambassadors, and
- Up to $500 in mini-grants for implementing projects or initiatives (limited availability).

Resources available to Green Ambassadors:

- Copies of the Green Homes Challenge brochures and handbooks,
- Brochures and resources from partner agencies and organizations,
- Free incentive gifts to distribute,
- OSER presenters for Powerware Parties, workshops, and other events, and
- The Low Carbon Diet or Green Living Handbook for leading Green Teams (per book cost $11-$15)

What are the Perks?

Each Green Ambassador receives:
- A Green Homes Challenge name badge and business cards, upon request.
- Recognition through the Green Homes Challenge web pages and other venues.
- Leadership experience to add to your resume.
- The priceless feeling of knowing that you're making a difference for our children's, community's, and planet's future well being!

For more information about the Green Homes Challenge or becoming a Green Ambassador, contact the Green Homes Challenge Coordinator at 301.600.7414 or GreenHomes@FrederickCountyMD.gov.

Green Ambassador Application & Commitment Form

Name: _____Date: _____
Street Address: _____
City, State, Zip: _____
Day Phone: _____ Evening Phone: _____ Cell: _____
Email Address:_____
Name of affiliated community in which you want to serve as a Green Ambassador (business, place of worship, community organization, neighborhood, etc.): _____
Please estimate how many people comprise this community: _____
Address (if applicable), or zip code, for this community:_____
_____

Will you be pairing up with another Green Ambassador in your community? ❑ YES ❑ NO
If yes, please provide the name of your Green Ambassador partner: _____
If you do not have a partner Green Ambassador identified, would you like us to connect you with a current Green Ambassador? ❑ YES ❑ NO

Please briefly describe why you are interested in serving as a Green Ambassador:
_____
_____
_____

Please select at least one primary role that you will fill as a Green Ambassador:

❑ Host at least two Powerware Parties, or other informational events or workshops.
❑ Navigate people through the Green Homes Challenge certification process
❑ Lead or organize a "Green Team" that meets regularly to support group progress
❑ Provide outreach assistance for the Challenge by helping to staff booths at community events or presenting to community or school groups.

If you have other ideas of the types of things you might like to do as a Green Ambassador, please share them here:
_____
_____

Please list three dates and times when you would be available for a one-on-one Green Ambassador orientation at the Office of Sustainability and Environmental Resources at 30 N Market St, Frederick. Preferred dates and times are Monday – Friday, between 8am and 5pm (Interviews are typically held within 1-2 weeks of receiving your application).

_____ _____ _____

What month/year do you want to begin serving as a Green Ambassador? _____
Please initial:
___I commit to serving as a Green Ambassador for one year.
___I commit to tracking my volunteer hours and keeping the OSER staff informed of my community's Green Homes Challenge activities by submitting the Quarterly Green Ambassador Update Form to GreenHomes@FrederickCountyMD.gov, or providing an update regarding my availability if I have no activities to report.

Signature: _____ Date: _____

Form also available at *www.FrederickCountyMD.gov/GreenHomes*

MAIL, FAX OR EMAIL TO:

Green Homes Challenge Coordinator, 30 North Market Street, Frederick, MD 21701
Fax: 301.600.2054 • Email: GreenHomes@FrederickCountyMD.gov

Office Use Only:
Reviewed by: _____ Date:_____
Accepted? ❑ Yes ❑ No ❑ Further follow up needed for decision.

I'm Taking the Green Homes Challenge!

Please fill out the following information. Items with * are required:

*FAMILY OR HOUSEHOLD NAME (e.g. The Jones, or The Smith-Jones Household) _____

*HOUSEHOLD CONTACT NAME: _____

*PHYSICAL STREET ADDRESS: _____

*CITY, STATE, ZIP CODE:_____

*EMAIL ADDRESS_____*DAYTIME PHONE NUMBER: _____

MAILING ADDRESS (if different from above):_____

I would like to participate in the (select all that apply):

❑ Power Saver Challenge

❑ Green Leader Challenge; Please give/send me my FREE home soil test kit ❑ Yes ❑ No

❑ Renewable Star Challenge (includes 2013 Solarize Frederick County volume purchasing initiative)

*GREEN HOMES CHALLENGE PLEDGE! *I PLEDGE to*

- Take action at home to reduce my household's environmental impact, and
- Keep the Challenge staff informed of my progress by responding to periodic surveys, emails, or phone inquiries.

**Signature:* _____

If you do not wish to have your name or photos used in our GHC promotional materials or media releases please initial here to opt-out. _____

RESOURCES!

Handbook Request:

❑ Please give/send me hard copy handbooks.

❑ I'll use online materials.

Newsletter Request:

❑ Keep me informed about energy, green living, and sustainability. Sign me up to receive Sustainable Frederick County's quarterly electronic newsletter.

HOW CAN WE BEST SUPPORT YOU?

❑ Navigator Request: I'd like a one-on-one "Navigator" to guide me to resources and help me achieve my goals.

❑ Give Me Time to Act on My Own, Then Follow-Up: I am a "do-it-yourself" person but also really busy! I'll take action on my own, but I'll be receptive to follow-up or periodic check-in calls.

❑ Prefer to Act Independently: I am a "do-it-yourself" person and do not want very much outside support.

❑ Green Team Request: I'd like to meet regularly with people in my community or network to stay motivated to achieve my goals. Help me get a Green Team started.

Continued

OUR PRIMARY INTERESTS

(select all that apply, and then circle the check mark next to your most important priority):

_____ Saving money on utility bills
_____ Energy conservation and learning what to do to save energy
_____ Renewable energy systems
_____ Reducing our household's impact on the environment
_____ Adopting greener behaviors and creating a healthier living environment in our home
_____ Concerns about Climate Change or Global Warming
_____ Making our home more comfortable in summer and winter
_____ I want to help create a better future for our children and future generations by conserving natural resources
_____ Other: _____

INTERESTED IN HELPING OTHERS?

I may be interested in helping to inspire my friends, colleagues, or neighbors to save energy and go green by…
(check all that apply)

❑ Hosting a Powerware Party, a fun, interactive gathering that increases "power awareness". Contact me and tell me more.

❑ Serving as a Green Ambassador to promote green initiatives in my network or community. Contact me and tell me more.

OUR HOUSEHOLD:

We live in a:

❑ Detached single family home ❑ A duplex or townhouse ❑ A multi-family apartment/condo

Year built: _____ Approximate square footage: _____

We:

❑ Own our home ❑ Rent our home

Total members in household: _____

Number of residents (optional):

Under age 18: _____ Ages 18 – 55: _____ Ages 55+: _____

Approximate Annual Income (optional):

❑ Less than $50,000 ❑ $50,000 - $100,000 ❑ $101,000 - $150,000 ❑ $151,000 - $200,000 ❑ Over $200,000

Our Household Members are (optional): *select all that apply*

❑ African American ❑ Asian ❑ Caucasian ❑ Hispanic ❑ Native American ❑ Mixed Race

❑ Other: _____

Registration can also be completed online at *www.FrederickCountyMD.gov/GreenHomes*

MAIL, FAX OR EMAIL TO:

Green Homes Challenge Coordinator, 30 North Market Street, Frederick, MD 21701

Fax: 301.600.2054 • email: GreenHomes@FrederickCountyMD.gov

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- U.S. Environmental Protection Agency
- Potomac Edison Home Performance and Energy Efficiency Programs
- Maryland Department of Housing and Community Development
- Chesapeake Bay Trust
- Frederick County Neighborhood Green

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Frederick County Office of Sustainability and Environmental Resources

The Frederick County Office of Sustainability and Environmental Resources advances practical solutions for protecting the environment, conserving energy, and living sustainably in Frederick County, Maryland. We integrate sustainable practices into County operations and initiate community programs that support our mission.

The Green Homes Challenge is our first comprehensive community initiative in sustainability. A sustainable community starts at home, and the Green Home Challenge educates, inspires, and supports households to take action and help ensure that the energy and natural resources on which we all depend are available for current and future generations.

Participation in the Green Homes Challenge contributes towards the EmPower Maryland initiative established by the EmPOWER Maryland Energy Efficiency Act of 2008. EmPower Maryland calls for reductions in per capita electricity consumption and peak energy demand by 15% by the year 2015. Participation also contributes to Maryland's Renewable Portfolio Standard (RPS), which specifies that 20% of the electricity sold in Maryland must come from renewable resources by the year 2022, and that at least 2% of the electricity must come from solar resources that are located in Maryland.

Front and Back Cover Wind Farm Photo Credit: By Leaflet (Own work) [Public domain], via Wikimedia Commons

Frederick County Office of Sustainability and Environmental Resources

Ensuring Our County's Future

30 North Market Street • Frederick, Maryland 21701

www.FrederickCountyMD.gov/GreenHomes